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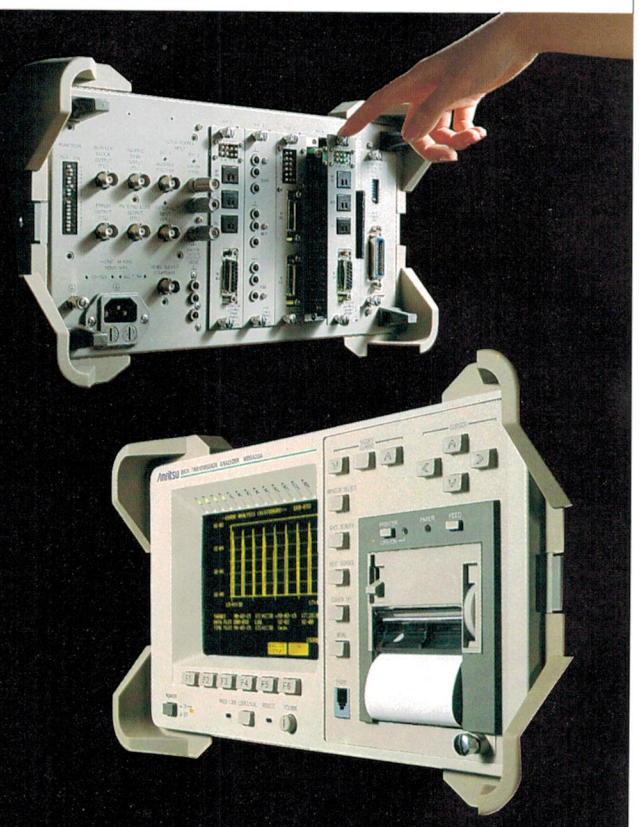
Data communications applications and traffic grow faster every year, spurred on by the increased availability of multimedia networks. Managing this diversity requires the versatility of Anritsu's new Data Transmission Analyzer MD6420A—the only one on the market that can hold up to 5 different plug-in interface or extension units at the same time.

But that's not all. There's no more worry about losing valuable online data and time when a power failure occurs, because the MD6420A saves test data in battery-protected memory. It also measures clock slips, for greater accuracy in any location. A new option even displays the histogram data automatically, freeing you from time-consuming graph plotting.

The MD6420A naturally conforms to the new CCITT G821, and offers an extensive variety of plug-in units to handle all types of interfaces, including digital lines from 50bps to 10Mbps. The printer is built in, and remote control via GPIB or serial interface is possible.

Plug into the new Anritsu MD6420A, where the best performance is backstage.

DATA TRANSMISSION ANALYZER MD6420A



Anritsu

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AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Australia's video pirates



In the international video distribution industry, Australia is seen as a hotbed of illegal copying. So much so that the industry has set up an office in Sydney to track down and prosecute the pirates — as Barrie Smith explains in his story starting on page 8.

Sony announces when MD will be released here



At last, Sony has announced when the first of its new MiniDisc recorders and players will be released in Australia: around September/October this year. As we explain on page 7, there will initially be three models: a portable, a home deck and a car unit. We'll be publishing Louis Challis' in-depth review of the new portable, in our September issue.

On the cover

Yaesu Musen has just released a new HF Communications Receiver, the FRG-100. We review the new set in this issue, starting on page 36. Yaesu distributor Dick Smith Electronics is also offering one of the receivers as a prize, in a new competition (see page 39). DSE also supplied the photo.

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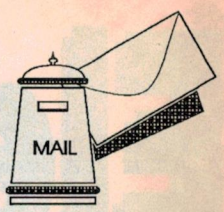
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LETTERS TO THE EDITOR



Circuit needed

I have a small problem which one of your readers may be able to solve.

I own an ageing, but good quality, Eumig FL-1000uP cassette deck which *EA* mentioned way back in the October 1979 edition in a column called 'Hifi Topics'. Unfortunately, quite recently my cassette deck developed a fault in it somewhere (power supply is OK but nothing happens). Because this deck uses a dedicated microprocessor to control many of its functions, I suspect that it may have something to do with it.

Could maybe a reader of *EA* somewhere please contact me in regard to how I can obtain a circuit diagram for the entire cassette deck. I am prepared to pay for even a good quality photocopy of a circuit. It is of vital importance that I get this deck operating again (for personal reasons) and any help from anyone would be of great assistance.

By the way, keep up the high standards *Electronics Australia*. I started buying it monthly in 1982 and since have obtained a complete library back to 1973 and an almost complete library back to 1960. *EA* is the ONLY magazine I need to buy to keep me abreast with the latest advances in technology.

Darren King,
PO Box 140,
Springvale, Vic 3171.

Comment: Thanks for the complement, Darren, and we hope a reader can help you.

Private training?

I am writing to you in the hope that you may be able to recommend some private electronics training institute (or private person) in the Brisbane area. Not just theory, but hands-on training leading to the ability to service radios and television sets.

I am not interested in TAFE. I have attended two costly courses (in other subjects) at Yeronga and have found the lecturers lazy and incompetent.

John Bolt,
Graceville, Qld.

Comment: Sorry John, but we don't know of any organisation or person we can recommend. Perhaps other readers can contact us with suggestions, and if so, we'll let you know.

Wants radios

After seeing the photo that Colin McKinnon took of his hole in the ground and the earth fill he was using I was slightly dismayed, and the hullabaloo that was created was well founded from a historical point of view.

But having no other method of getting rid of his radios with even a little payment (Colin as I remember him writing couldn't even get petrol money), I think he had good reasons to do what he did.

Therefore I am writing, asking *Electronics Australia* to publish this letter so as to inform any other people who are despaired by the amount of radio junk in their garages and houses that they don't know what to do with, and with the amount of possible nagging they get from their spouses. I will gladly pay something reasonable for the radios or parts I receive, and willingly pay petrol money for the travelling incurred (it would be easier, but not necessary for the radio parts to be dropped off, as I don't have a car and rely on public transport or personal transport — my parents).

So to the readers of *EA*, if there are any old radios or parts about to be thrown out or of no use to yourself, please contact me and we should be able to organise something.

Colin Irwin,
15B Colwell Crescent,
West Chatswood NSW 2067.

Larger than life

Just flicking through my collection of your magazine when I came upon the January 1993 issue featuring the 'Enhanced Mk2 VK Powermaster'. After a close look and the schematic I found something that puzzled me.

This was the fact that four 100,000uF capacitors were used after the bridge. To me this seemed just a little too high, after all we do have the transformer to power the circuit. I started reading, and found the text to mention four 10,000uF capacitors. I assume this to be the correct value and the other an unfortunate misprint.

Richard Adamec,
Gold Coast, Qld.

Comment: You're right, Richard. The correct value for the capacitors is 10,000uF, as quoted in the text..

Nomis clarified

It was most interesting to read the two stories that appeared in the "When I Think Back' segment of *Electronics Australia* regarding Laurie Simon and Nomis Electronics.

As mentioned in your article Nomis Electronics is now known as Network Nomis. We believe that there is some confusion as to who Network Nomis is.

Network Nomis Pty Ltd is the third company to own the business name Nomis Electronics, since Laurie Simon sold the company. Network Nomis Pty Ltd (formerly Network Hire Pty Ltd) acquired the business name 'Nomis Electronics' from the previous owner in May 1991.

Network Nomis Pty Ltd has traded for the last two years as Network Nomis, and is currently working to re-establish the public address side of the company to the reputation it enjoyed under Laurie Simon. Network Nomis Pty Ltd has a full time staff of 15 and has traded successfully (previously as Network Hire Pty Ltd) since 1982.

The company has three main operating divisions: hire, sales and videoconferencing. Network Nomis is involved in a number of activites from the installation of the PA and television distribution system at the Australian Formula 1 Grand Prix to the installation of TAFE Channel, Australia's largest videoconferencing network. Our day to day activities include hire and sales to private, corporate and government clients.

The company is predominantly SA based, but has worked in all Australian states. We have eastablished a good relationship with Laurie Simon and look forward to a successful future.

Graham Williams, MD
Network Nomis,
Eastwood, SA.

Amateur licence

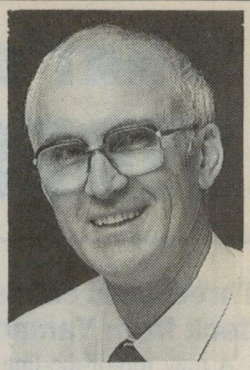
One thing that Tom Moffat forgot to mention in his packet radio articles, (he may have mentioned it, but I missed it) is how/where one goes about getting a suitable ham radio and licence relatively cheaply.

I'm sure that there are also other readers out there who would appreciate any help on this subject.

Cory Seligman,
Essendon, Vic.

Comment: We published an article by Tom in the June issue, which gave a lot more information on this, Cory. You can also get a lot of assistance from the Wireless Institute of Australia, PO Box 300, South Caulfield, Victoria 3162.

EDITORIAL VIEWPOINT



The Pay TV debacle...

Over the years, Australia seems to have become quite adept in either delaying or fumbling its adoption of new technology, often managing to take it up significantly later than the other so-called 'developed' countries. The explanation usually given by our politicians and bureaucrats is that the policies and technologies adopted in other countries are not necessarily appropriate here, and that as a result they must consider and plan everything from scratch, supposedly to ensure that mistakes are not made. Big Brother knows best, in other words — despite the fact that many of the past decisions made by these particular Big Brothers have been disasters (like our oddball VHF TV channels, and the way they delayed FM broadcasting).

But even when you take this tradition of delaying and fumbling into account, surely the currently unfolding Pay TV debacle must set some kind of record. If the implications weren't so serious, it would make an ideal subject for a comic opera or TV farce, along the lines of the British series 'Yes Minister!'

First we had years of delay, justified by the need to allow existing broadcasters to become viable; then there were further delays while we waited until better technology had been developed. Then we were at last going to proceed, and with a 'technology neutral' policy to ensure that subscribers and providers could take advantage of all viable approaches. But when intending providers have attempted to pursue technologies like microwave distribution, they've been continually thwarted — and it has now become clear that the Government has quietly but firmly decided to allow only one primary technology: direct satellite delivery.

Any small credibility Australia may have built up overseas, for belated but at least 'sensible' adoption of important new communications technology, must by now finally be in tatters. Surely we couldn't have chosen a more unfortunate way to approach the forthcoming era of global digital broadcasting...

Our new masthead

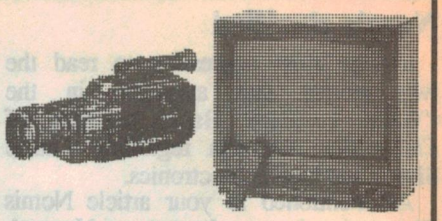
Changing the subject, did you notice the new logo on our contents page this month? It's a preview of our bold new masthead, which will appear on the front cover as well from next month.

Every magazine's masthead needs to be smartened up from time to time, to keep pace with the times — especially a magazine like *Electronics Australia*, covering as it does a field changing as fast as electronics. The last time we updated our logo was a full nine years ago, so it's certainly time for a change.

I'm delighted with our 'new look', which seems to me far more in tune with our goal of keeping you up to date with modern technology. I hope you'll agree, and that you'll look forward to seeing us in our latest form next month.

Jim Rowe

What's New in VIDEO and AUDIO



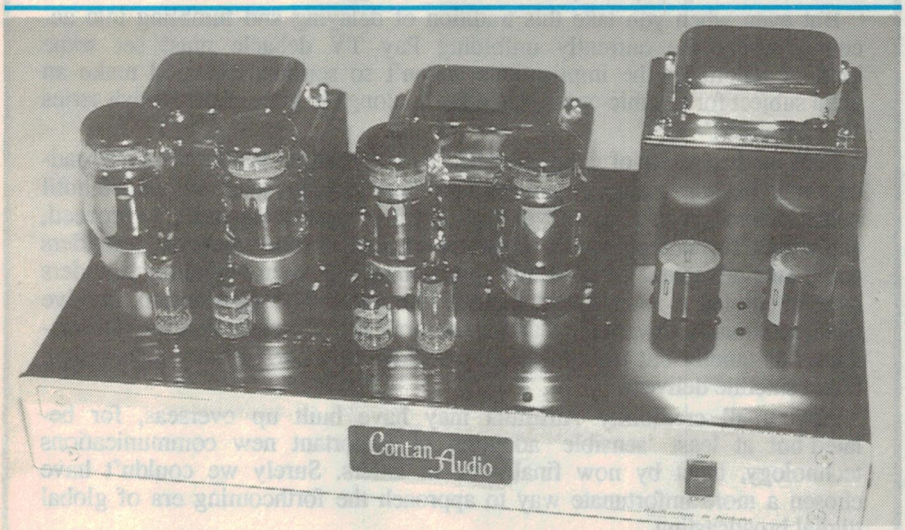
Three head cassette deck from Yamaha



A new top-of-the-line single-well cassette deck has been introduced by Yamaha Corporation, which provides the performance and convenience of a three-head model at the suggested retail price of $699. Designated KX-670, the new model is the first with separate record, playback, and erase heads ever offered by the company at this price point.

With independent record and playback heads, no compromise is needed, and each can be designed for the best performance possible. Greater frequency response can be achieved. The KX-670 uses low impedance GF record and playback heads and has a frequency response of 20 to 21,000Hz, +/-3dB with metal tape. Since it has separate record and playback heads, the KX-670 can accurately monitor recording and allow for the comparison of source to tape while recording is in progress. This important convenience is vital for critical recording and allows the highest recording quality possible.

The new deck also uses a closed-loop dual capstan transport to assure superior tape-to-head contact and uniform tape tension. This system, combined with Yamaha's new Sorbothane cassette stabiliser dampers located in the cassette door, is responsible for the exceptionally low wow-and-flutter specifications. The transport also uses a DC three motor drive system. One motor operates the capstan drive, one the reel drive, and the third handles the mechanical drive.



Locally made 120W valve hifi amplifier

Melbourne firm Contan Audio has just released a new high-quality valve stereo power amplifier for music lovers, the CTS-60. The new model offers 60W maximum per channel, with a frequency response of 4Hz - 100kHz (-3dB). It uses two closely matched KT88 output valves and two 6DJ8 valves per channel.

Designed and manufactured in Australia, each amplifier is hand built and stringently tested to ensure that it meets specifications.

Input sensitivity is 1.0V RMS (100k) for full output, and the amplifier's power requirement is 350VA for maximum power output.

Measuring 430 x 250 x 200mm and weighing 22kg unpacked, the CTS-60 uses custom wound wide bandwidth output transformers and operates the output valves in class AB ultralinear mode. It can optionally be arranged to operate in class A mode, with lower power output. High quality components are used throughout, including polypropylene and polycarbonate capacitors and metal film resistors.

The amplifier carries a one year limited parts and labour warranty, with only a six-month warranty on the valves. It carries a recommended retail price of $2700, which is less than half that of comparable imported models.

Further information is available by circling 181 on the reader service card, or contacting Contan Audio, 37 Wadham Parade, Mount Waverley 3149; phone/fax (03) 807 1263.

New speaker line from Kenwood Electronics

Kenwood Electronics has introduced a new line-up of quality speaker systems known as the LS Series.

Speaker manufacturing is in many cases a 'cottage industry' affair, with many countries opting to design speaker systems to suit local tastes and furnishings. Kenwood not only wanted to develop a speaker line-up that would satisfy the Japanese domestic market, but as importantly the discerning German and European markets. Design engineers therefore focused on achieving overall flat response, smooth phase characteristics, wide dynamic range and very importantly a system that would present a constant impedance load to the amplifier. The speaker systems also had to present an outstanding finish that would blend into any stylish and contemporary lifestyle.



Assembled and finished in Germany, the LS speakers are crafted with the attention to detail German speakers have become renowned for.

The LS-1000G is a three way, three speaker floor standing type bass reflex system, with a maximum power input of 160W, a frequency range of 35Hz - 22,000Hz, a sensitivity of 87dB, and an impedance of four ohms. It uses a paper cone 10"/250mm woofer, a paper cone 5"/130mm midrange and a soft dome type 1"/25mm tweeter.

The LS-700G is also a three way, three speaker floor standing type bass reflex system, with a maximum power input of 120W, a frequency range of 35Hz - 22,000Hz, a sensitivity of 87dB and an impedance of four ohms. It uses a paper cone 8"/200mm woofer, a paper cone type 4"/100mm midrange and a soft dome type 1"/25mm tweeter.

The LS-500G is a two way, two speaker floor standing type bass reflex system, with a maximum power input of 100W, a frequency response of 40Hz - 22,000Hz, a sensitivity of 87dB, and an impedance of four ohms. It uses a paper cone 6.5"/160mm woofer/midrange driver with a 1"/25mm tweeter.

The Kenwood LS Series speakers are covered by a three year parts and labour warranty and are available at selected Kenwood A/V Concept dealers. For further information on the LS Series speakers or your nearest Kenwood dealer contact (02) 746 1888.

Sony announces MiniDisc release date

Sony Australia has at last announced the release data for its next generation audio format, MiniDisc (MD): the first products are expected to be available on the Australian market in September/October this year.

Sony will launch three models of the MD format, including the Sony MZ1 portable unit with a target price of $1500, the MDS101 home stereo deck with a target price of $1800 and the MDXU1 car stereo system with a target price of $1900.

In addition, Sony will launch blank MiniDiscs for recording purposes. Recordable MiniDiscs will be available in two models - the MDW60 with one hour of recording time and a target price of $21.95, and the MDW74 with 74 minutes recording time and a target price of $25.95. Sony MiniDisc is the world's first recordable and eraseable digital audio disc for consumers, featuring the random access feature of Sony's co-developed compact disc technology.

"Sony developed MiniDisc in answer to consumer demands for an audio format with the same portability and easy of use as the analog cassette, with improved sound quality and random access features," said Garry Beauchamp, Sony's Manager New Business Development.

Permanently housed in a protective cartridge like a computer disc, the 64mm diameter MiniDisc is thin and compact and offers up to 74 minutes of playing time with no sound degradation from repeated playings.

Approximately 200 pre-recorded software titles for MiniDisc will be available simultaneously with the Australian launch, from major recording companies.



VHS-C camcorder is easy to use

Panasonic Australia believes its NV-S20 video camera gives consumers unprecedented value for money and easy of use. Panasonic's new one-touch selection dial (known as the AE dial) gives users simple, easy access to selecting auto, manual, sports, portrait and low light modes.

The palmcorder then automatically adjusts white balance, iris and focus to ensure accurate, clear pictures. For example, in sports mode, the shutter speed on the S20 is automatically set between 1/50th and 1/500th of a second to clearly capture the subject's movement, depending on the scene's brightness. Manual mode gives enthusiasts the opportunity to make adjustments themselves.

The combined power on/recording switch has been introduced to prevent accidental recording. In addition, a large display of the words 'record' and 'play' in the viewfinder ensures users know the present shooting conditions. Operation buttons have been enlarged for easy operation. The addition of a wide angle lens (8x zoom, 5 - 40mm) is a first for Panasonic, recognising the increasing use of video cameras indoors.



Recommended retail price is $1759. ❖

signals in each speaker would be fed into an 80 watt low-mid frequency and a 20 watt high frequency amplifier, which are integrated into the back panel of each of the speaker systems.

The release explained how the new digital speaker system had been optimised to fulfil multi-room sound system applications, and that by means of a single cable run each speaker is connected to the next, using a 'daisy chain' connection system. By this means the system provides both the digital signal, all required system control functions (in terms of specific source and related sound level, for each set of speakers), and a desirable level of simplicity which all of us seek.

Philips' concept is based on one controller providing simple and flexible control over almost as many loudspeakers as you might reasonably require, up to a stated maximum of six pairs, which you may wish to install in a suggested three room configuration. The sound level in each room may be individually controlled from either the DSC 950 controller, or within the room itself by means of an infra-red remote control unit. The system will accept inputs from a wide range of interconnected sources; however, only one of those sources would be able to provide input to the system at any one time.

My impression of the DSS 930's during my brief inspection and its demonstration in the Philips penthouse suite at the Sahara Hotel, was that this was indeed a technologically exciting development, which was very innovative. The speaker system's dimensions and appearance were also clearly appropriate for a large proportion of prospective residential applications in Australia. Alas, as is so often the case in this land 'down under', we had to wait until mid-1993 before Philips Australia finally brought the first pair of DSS 930's to Australia, and offered *EA* the opportunity to review them.

Avant garde

The concept underlying Philips' digital loudspeakers is unquestionably *avant-garde*. The Philips approach has been to convert any or all of the analog signal inputs which may be required by a composite system of this type into a digital signal, on which the required control information may then be superimposed using a DSC 950 digital system controller. Without that system controller, you are unable to use your digital speakers.

The DSC 950 controller is a neat little box which is supplemented by its remote controller, and which enables you to select from a wide variety of inputs which include satellite receivers, CD players, DAT recorders, DCC players and recorders, digital or conventional tuners, TV sets, VCRs, laser disc players, record players and of course conventional compact cassette players — all of whose dual channel signals are either maintained in their original digital form wherever possible, or alternatively, where provided in analog form, are converted into a digital signal by means of the analog-to-digital converters in the DSC 950.

The DSC 950 provides the added capability of integrating and superimposing appropriate control functions, so that the user can nominate separate loudness levels for each of the three speaker systems, designated as 'A', 'B' and 'C', and deactivating those channels, should that be required. Each of those three systems may have as many as four speakers, (two left channels and two right channels); and although I did not put it to the test, it appears that, because there is no power drain on the coaxial system, the number of speakers that you actually interconnect could conceivably be far greater in number than the 12 that the Philips literature suggests as an upper limit.

The interconnection between each of these speakers is provided by means of a single thin coaxial screened cable, at each end of which a conventional gold-plated RCA plug is provided. The interconnection of each of the speakers is literally 'kid stuff', as the annotated connections on the back of each speaker are extremely simple, and quite straightforward. However, it is not inappropriate to point out that most kids now run rings around their parents when it comes to assembling and operating the latest generation of equipment!

The DSS 930 speakers are both technically and to a minor degree, visually different from the previous generation and current norm for loudspeakers. An examination of the curved front panel, which is fabricated from a very solid black perforated metal, reveals the presence of three speakers behind — the two lower units being 130mm diameter conventional dynamic drivers with polypropylene cones, and an isophase tweeter (which I would describe as a leaf tweeter) at the top of the cabinet.

Flexibility

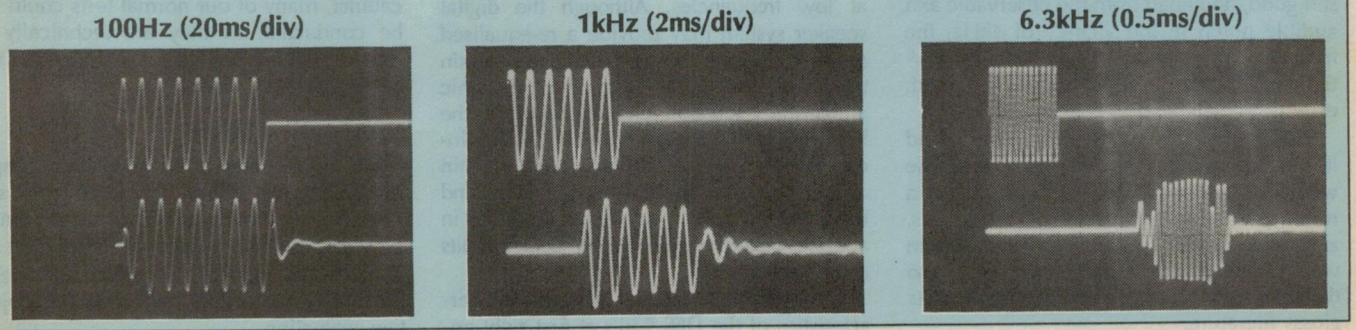
The block schematic which is stencilled on the back panel of each speaker enclosure reveals that the designers have provided a functional flexibility which is only limited by their ingenuity. Their aim was clearly to implement acoustical and electro-acoustic capabilities which many of their competitors have been experimenting with for many years, and not surprisingly Philips have been the first to master them, and develop a commercial system.

Whilst the block schematic shows how the system may achieve all of the vaunted claims made in the 1992 press release at Las Vegas, there are, as I soon discovered, 'many a slip twixt the cup and the lip' when you compare a pre-production prototype and a production version. There are frequently differences between the individual products, which may not necessarily conform to the standards that may well have been achieved in the original prototype.

The key features of the DSS 930 are its ability to input a digital signal, which is then pre-processed in the digital sound processor (DSP chip) to provide specific acoustical capabilities. That chip offers the potential to correct or adjust for inherent and/or individual acoustical defects, or deviations from the norm. If correctly adjusted or optimised, each speaker unit could or should perform in a truly identical manner with the prototype. The attributes of the original prototype may then be duplicated in terms of frequency and phase response etc, independent of other characteristics the individual components might otherwise display.

Having corrected and linearised the performance of the signal, the digital signal may

Tone Burst Response of Philips DSS 930 Speaker System
(For 90dB Steady State SPL at 1m on axis)
Upper Trace is Electrical Input - Lower Trace is Loudspeaker Output



be divided into two digital signals (one low and mid-frequency, and the other high frequency signal), which are then individually adjusted in volume by means of a pair of digital volume controllers. The digital signals are then converted back into a pair of analog signals, which are then amplified by the respective amplifiers, one being an 80 watt amplifier and the other being a 20 watt amplifier serving the isophase tweeter.

The pair of low frequency mid-frequency drivers are installed in a solid and sealed enclosure. The isophase tweeter is mounted in its own separate enclosure at the top of the speaker cabinet. The electronics are all mounted behind the back panel, which has been fabricated as a large heat sink to dissipate the heat, and each speaker enclosure has its own mains power lead.

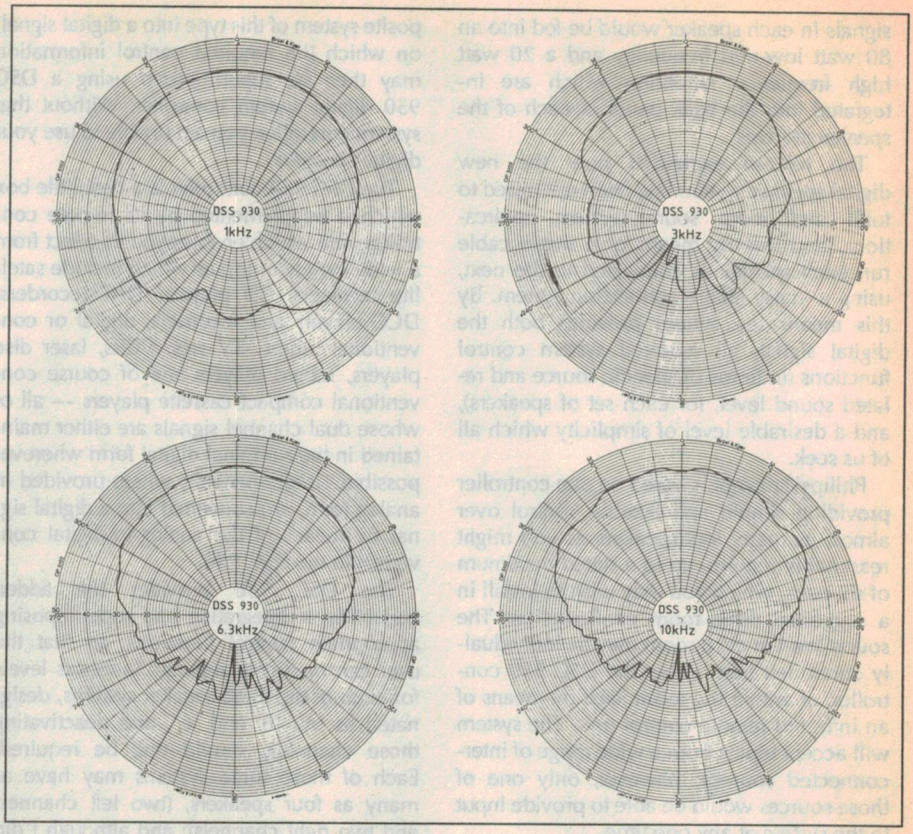
Each of the DSS 930 digital speakers has its own infra-red control system, with the IR detector incorporated behind the lower edge of the front panel. The small number of controls and switches are provided on the back panel which allow the user to select for left channel or right channel, into which of the three systems it is meant to be integrated (i.e., 'A', 'B' or 'C'), as well as an 'on/off' power switch. The length of power lead provided with the speakers is in my opinion inadequate at 1.5m. In many cases this must generate the need for an extension lead, which would appear to be a marketing oversight.

Objective testing

The objective testing of the DSS 930's proved to be far more simple and straightforward than I might have otherwise expected, leaving aside the number of unexpected calls on my time, which initially upset the testing schedule and impinged on the time available to perform the task.

We placed the DSS 930's on the B & K turntable in our anechoic chamber, and were immediately disappointed to observe that although the Philips literature claims that the new digital technology would obviate the conventional crossover notch between the mid-low driver units and the isophase tweeter, there was still clearly a notch there for all to see. Notwithstanding, the anechoic 'on-axis' frequency response is still good, and apart from the observable and audible notch in the vicinity of 4kHz, the frequency linearity is certainly better than +/-6dB from 60Hz — and it should be noted, extends to well beyond 20kHz.

Installed in a real room with a wall behind it, the drooping low frequency response would be appropriately enhanced as a result of rear wall and side wall reflections, and the overall linearity of the system would either match or come mighty close to the performance which Philips claims in its glossy literature.



Here are the polar response plots for the DSS 930 system, at frequencies of 1kHz, 3kHz, 6.3kHz and 10kHz. As you can see, the dispersion is very smooth indeed over an arc of +/-60 degrees from the tweeter axis — an excellent performance.

We progressed with the evaluation of polar responses of the DSS 930, and were pleasantly surprised to find how smooth the polar plots are over a +/-60° arc — achieving what I would regard to be one of the smoothest performances I have seen from any speaker system in quite a while.

The isophase speaker, which I still believe is a leaf tweeter, is particularly good, and would appear to be one of the best tweeters that Philips have yet offered in any of their consumer products. The dispersion characteristics of this tweeter are positively outstanding, and as I will subsequently recount, their acoustical characteristics are equally outstanding.

We progressed to an assessment of the distortion characteristics of the DSS 930's, and soon discovered that although the distortion characteristics are relatively low at high frequencies, conversely they are relatively high at low frequencies. Although the digital speaker system may provide a re-equalised signal, this can only be achieved within the limits imposed by the dynamic amplitude excursion characteristics of the low frequency drivers. As the amplitude increases, each of these drivers operate within an ever increasingly non-linear region, and this in turn results in significant increases in audible distortion which the DSP circuits cannot obviate.

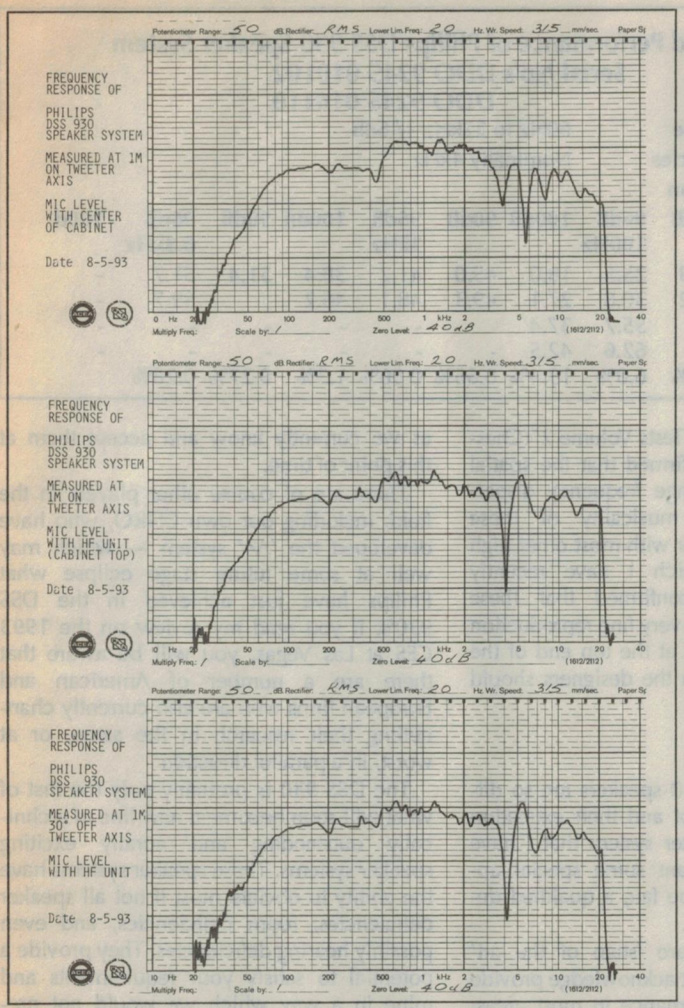
The phase response and group delay characteristics of the DSS 930's at first sight appeared to be reasonably smooth, however on closer examination one becomes aware of the multiplicity and the rapidity of the phase changes at high frequencies, which are obviously associated with the DSP circuitry. An examination of the tone-burst testing reveals obvious signs of transient ringing at 1kHz, with a far more pronounced ringing characteristic at 6.3kHz.

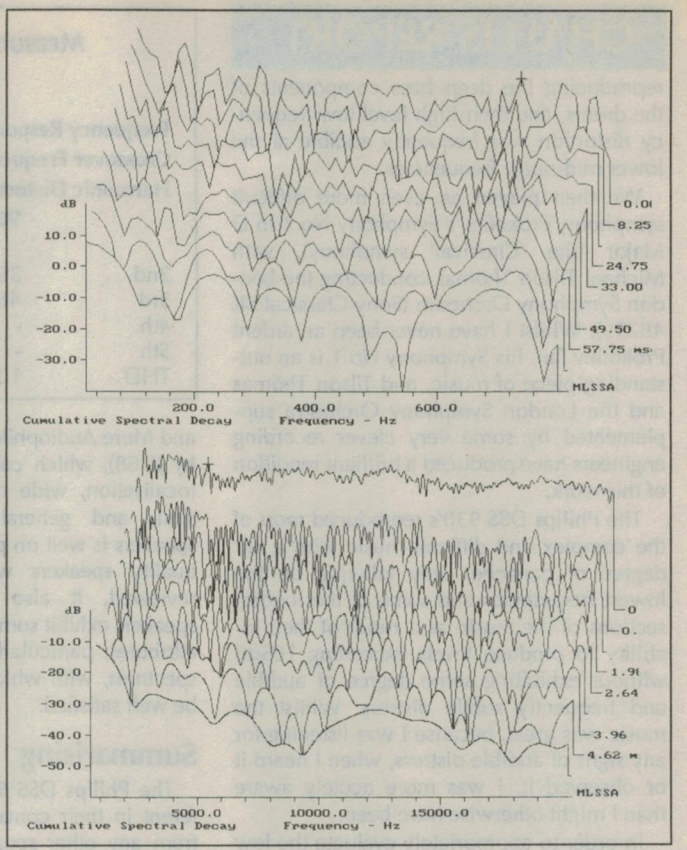
The cumulative decay response assessment in the anechoic room also reveals signs of low level ringing in the vicinity of 600Hz, as well as in the 4 - 6kHz region and also the 13 - 14kHz region. Ringing characteristics of this type are however common in most quality speakers, and we have yet to see a speaker system which does not exhibit some degree of colouration associated with speaker or cabinet resonances.

Because of the presence of amplifiers and integrated electronics all within the one cabinet, many of our normal tests could not be conducted, as they are technically irrelevant within the integrated design context of the DSS 930 system.

Subjective tests

Having completed my objective testing, I loaded my car with the six large cartons of equipment which Philips had kindly provided for the subjective evaluation — which they appear to regard as being potentially more important than the objective evaluation.





Above are the cumulative spectral decay plots for the DSS 930 system, for low and high frequencies respectively. At left are the measured frequency response curves at 1m, taken level with the cabinet centre, on the tweeter axis and at 30 degrees off axis. Note the notch at about 4kHz.

This comprehensive system with which I was provided included the pair of DSS 930 speakers, a DSC 950 controller (without which the speakers are unusable), a DCC 900 digital compact cassette deck, a CD 920 CD player, an FT 920 synthesised tuner and a DSC 950 power amplifier, which I did not use.

Philips were also perceptive in that they also provided a CD and matching DCC cassette featuring the same program material. On the disc and the DCC, Claudio Abbado conducts the Berliner Philharmoniker in 'Gustave Mahler - Symphonie No 1'. Philips also provided a DCC Audio Performance Compact Cassette Tape, which I had not previously seen, and which every serious audiophile will wish to own.

I found I needed two trips to get all the boxes home, but I was finally able to set the system up in my listening room — which on this occasion required more power points than I had ever needed before. Despite this the system still proved to be far easier to set up than I might otherwise have anticipated.

The system and its interconnection has been simply and cleverly colour coded, so that even Granny could put it together; it doesn't even need the kids to get you out of strife. For once Philips have designed a system which is ergonomically simple in its assembly, and after assembly, the only catch is that with the vast array of separate remote controls, you have to learn which controller has to be used in the correct sequence to achieve the control over the device you actually wanted to activate and control!

Whilst the software Philips was kind enough to provide is excellent, I chose to start my evaluation using a test disc with pink noise — to evaluate the overall smoothness of the sound of the loudspeakers, and determine the extent to which they exhibit any signs of tonality or non-linearity. This is rapidly achieved with a pink noise, and your own ears become the measurement instrument.

As I soon discovered, the audible characteristics and nuances of these speakers are not quite as smooth as I might have desired, nor what I would have expected, on the basis of the PR material. Although the response was reasonably smooth, I would really have expected a slightly smoother performance than that which my listening panel and I subsequently heard.

We progressed to an evaluation of how well the DSS 930's perform on voice, and especially singing. For this test we used a new release of Verdi's *Don Carlo* opera, conducted by James Levine with the Metropolitan Opera Orchestra and chorus. This is an outstanding rendition, featuring the latest in hi-tech recording with 20-bit technology supplemented by the very latest in recording technology, which I must applaud. Each of the main character roles has been carefully selected to provide a star-studded cast, which even includes Kathleen Battle, in a minor role in which she also unquestionably stars.

This particular release of the opera is an absolute gem, and as we soon discovered, the DSS 930's absolutely shone — providing a level of fidelity on voice and singing which was outstanding. Every singer's note was clear and almost true to life, providing an outstanding and rare pleasure. We played a number of other discs incorporating singing and singers, and on each and every occasion, the DSS 930's provided an equally outstanding performance, for which we allocated top marks.

We progressed to more demanding software as typified by Mahler's Symphony No 1 featuring Claudio Abbado, with the Berliner Philharmoniker (Deutsche Grammophon 431769-2), which although Mahler's first, is nonetheless an outstanding and moving symphony, and the disc is particularly good.

Whilst the DSS 930's performed well for most of the music, they were incapable of

reproducing the deep bass components of the drums, and their high level low frequency distortion was frequently audible at the lower mid-range frequencies.

We then played an even more difficult symphony, Prokofiev's Symphony No 1 in D Major (the 'Classical' symphony), with Michael Tilson Thomas conducting the London Symphony Orchestra (Sony Classical SK 48239). Whilst I have never been an ardent Prokofiev fan, his Symphony No 1 is an outstanding piece of music, and Tilson Thomas and the London Symphony Orchestra supplemented by some very clever recording engineers have produced a brilliant rendition of this work.

The Philips DSS 930's reproduced most of the complex and difficult music with a fair degree of panache, only faltering on the lowest frequencies and some of the loudest sections of the music as a result of their inability to produce levels exceeding 105dB without exhibiting some degree of audible and frequently subtle distress. Whilst the music was great, because I was listening for any signs of audible distress, when I heard it or observed it, I was more acutely aware than I might otherwise have been.

In order to appropriately evaluate the low frequency dynamic response of the speakers, I briefly played the 'Sheffield Drum Record' (Sheffield Lab CD-14/20), which would have to be one of the most difficult test discs with which to test a speaker system or its associated amplifier's low frequency performance.

Whilst the performance was adequate, or marginally adequate at modest listening levels, (i.e., less than 90dB), any attempt to turn up the volume was quickly matched by strong and disturbing complaints from the speakers, which objected to the low frequencies involved and audibly distorted their truncated output.

The last disc I played was 'Chesky Jazz and More Audiophile Tests Volume 2' (Chesky JD68), which confirmed that the spatial localisation, wide range frequency dispersion, and general musicality of these speakers is well on par with most other high quality speakers which I have recently reviewed. It also confirmed that these speakers exhibit some very fine reproduction attributes, particularly at the top end of the spectrum, with which the designers should be well satisfied.

Measured Performance of Philips DSS 930 Speaker System
Serial No's DDO 9245 010102
DDO 9245 010110

Frequency Response	60Hz to 22kHz +/-6dB
Crossover Frequencies	Nominally 4kHz

Harmonic Distortion

	90dB	96dB 100Hz	100dB	90dB	96dB 1kHz	100dB	90dB	96dB 6.3kHz	100d
2nd	36.9	25.5	18.0	45.0	41.2	38.4	51.4	51.7	-
3rd	46.2	30.8	27.1	49.3	48.1	46.2		59.7	-
4th	-	55.7	37.4	-	-	-	-	-	-
5th	-	62.6	42.5	-	-	-	-	-	-
THD	1.5%	6.0%	13.4%	0.66%	0.96%	1.3%	0.27%	0.28%	

Summarising

The Philips DSS 930 speakers are so different in their concept and their execution from any other speaker system that I have reviewed as to warrant some special approbation — and to be fair, a qualified degree of condemnation.

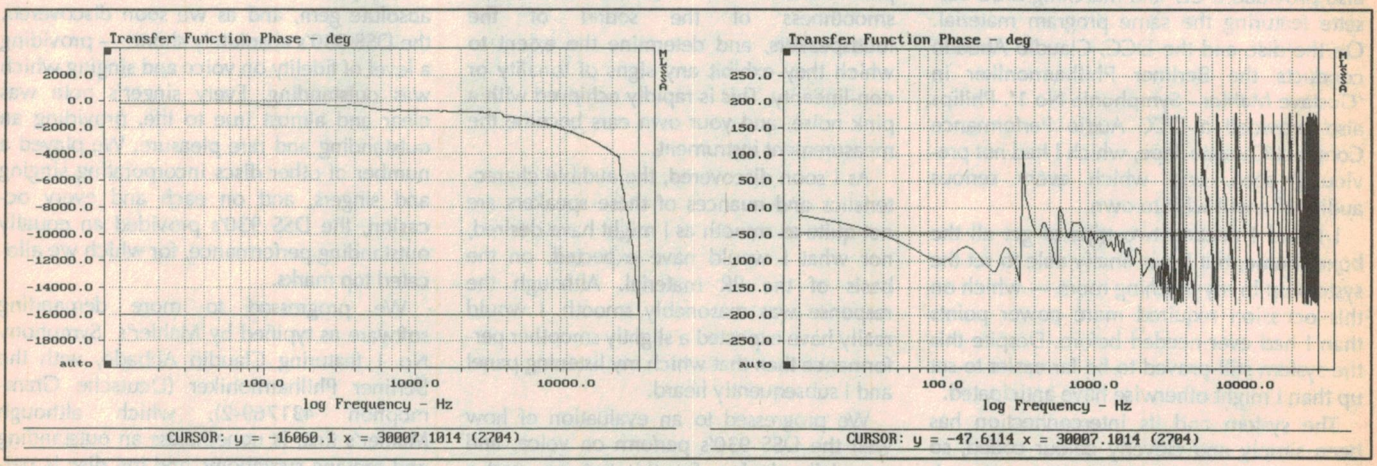
Technically these are 'state of the art' speakers, which I must acknowledge provide an outstanding performance in most areas, whilst at the same time they fail to achieve all of the claims made about them in their manufacturer's PR material.

With the addition of more advanced and hopefully more innovative DSP chips, and with larger and more effective bass speakers, the next and larger version of these speakers will hopefully have the ability to provide a performance which may well prove to be the nemesis of the conventional speaker system, as we currently know and accept them at this point of time.

There are of course other players in the field, including our own CSIRO, who have developed the 'A4' system — which may well at some future stage eclipse what Philips have just achieved in the DSS 930's. If you read my review on the 1993 CES at Las Vegas, you will be aware that there are a number of American and European firms who are also currently channelling their research in the same, or at worst, in a parallel direction.

The DSS 930 is probably only the first of what will soon become a new line of technically outstanding and aurally exciting speaker systems. These speaker systems have the ability to obviate most if not all speaker deficiencies, room deficiencies, and even possibly hearing deficiencies. They provide a potential to satisfy your requirements and mine in a way which we would not previously have imagined possible.

The dimensions of each DSS 930 speaker box are 575 x 229 x 825mm (H x W x D), and they weigh 16kg each. The recommended retail price for a DSS 930 system (complete with matching DSC 950 unit) is $5699. You should be able to find the system at any hifi dealer stocking high-end components, and presumably those who specialise in Philips products. ❖



At left is the transfer function phase characteristic for the DSC 950 digital signal processor, which forms an integral part of the Philips digital speaker system, shown in 'unwrapped' form where it looks relatively smooth. However, when displayed in the more usual 'wrapped' form (constrained to within +/-180 degrees), the phase discontinuities are much more evident.

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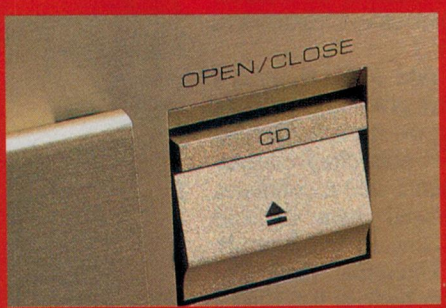
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Hurry Offer Ends 24.9.93

Arthur Cushen looks back on

OVER 40 YEARS OF SHORTWAVE LISTENING

Our Shortwave Listening column has been popular with readers for many years. Since October 1952 it has been written by New Zealander Arthur Cushen MBE, who has spent a lifetime listening on the shortwave bands and reporting on international broadcasting activities. Recently Arthur looked back over his years as a shortwave monitor, correspondent and broadcaster, and sent us this pen picture for the benefit of our newer readers.

The changes from giving frequencies in kilohertz (instead of kilocycles) and times in UTC (instead of GMT or 'Greenwich Mean Time') are only two of the things that have occurred since I began writing about shortwave listening, in what was then called *Radio and Hobbies*. Back when I started, in October 1952, the column was called 'Shortwave with Arthur Cushen'.

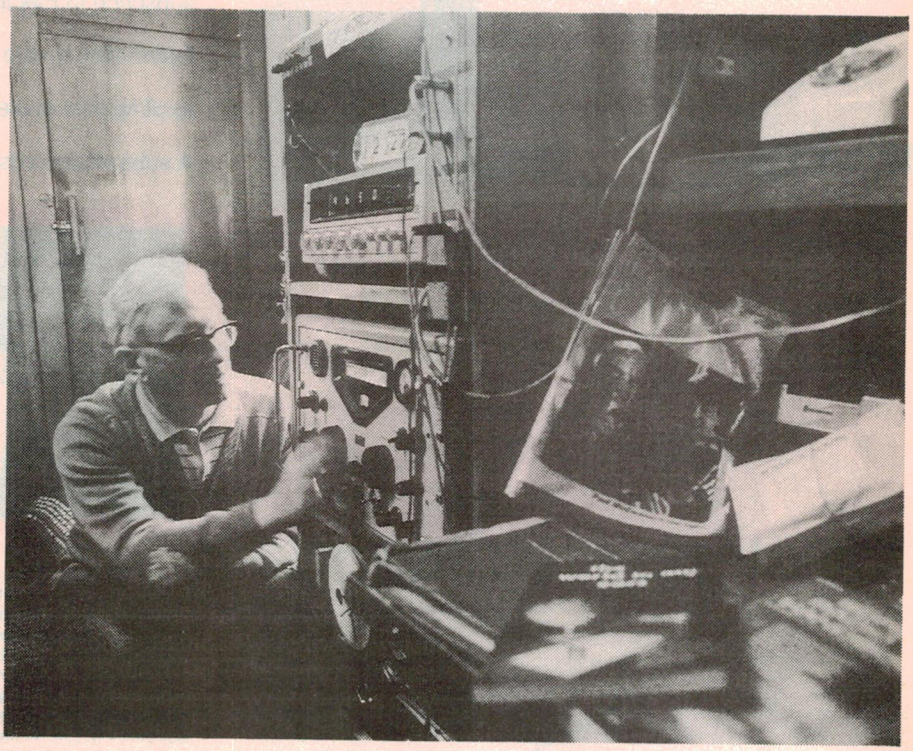
Actually in the first few columns, I notice that times were given in Australian Eastern Time, using the normal AM and PM. But later, the 24-hour clock became the main time reference and it continues today, having changed from the old Greenwich Mean Time to the recently adopted UTC or 'Universal Time Co-ordinated'. Likewise, back in the 1950's the frequency reference for stations was given in kilocycles, and now we give it in kilohertz — but this is a change of name only, with no difference in the actual frequency.

A highlight of the first column was an item about a new international service from Belgium, which replaced the OTC transmissions from Leopoldville in the Belgium Congo. OTC had maintained a radio service during the war years when Belgium was captured by the Germans. Following the end of the war, the services were gradually transferred back to Belgium and in later years Belgium Congo became independent. Now of course it's the Republic of Zaire, with Kinshasa as the capital.

By October 1962, the publication was known as *Radio Television and Hobbies* and the column's feature item was 'New 250kW Transmitters for Radio Canada International'. These were replacements for the original 50kW transmitters at Sackville, which came into operation in 1946.

A decade later, the publication was renamed *Electronics Australia* and the shortwave column was also retitled 'Listening Around the World'. The feature item for October 1972 looked at the expansion of Radio Canada into international broadcasting.

Another 10 years later again, in May 1982, the column appeared under the heading 'Shortwave Scene', and the main item was on the World Administrative Radio Conference which had been held in 1979, and a report that the decisions of WARC were now taking shape.



Some of the more modern receiving equipment used by Arthur Cushen. Racal RA17 is an old stalwart while the McKay Dymek above has been converted so that a blind listener can find frequencies quickly.

Receivers, old and new

When the column started in 1952, I was using an English Ekco seven-tube receiver which I purchased in 1939. All my war time monitoring, both for prisoner of war messages and for Security, was done using this set. The Ekco has a most interesting dial; it is covered with the names of exotic and long forgotten stations such as Wayne, Zessen, Capetown, Daventry, Schenectady, Allahabad, Rangoon, Nafeking and many more. The dial is scattered with these locations and one presumes that it

Video & Audio: The illegal side of technology

VIDEO PIRATES ABOUND IN AUSTRALIA

After slow initial growth, illegal copying of videotape cassettes is now a thriving business with an annual turnover in Australia of around $12 million. Its future looks even brighter, thanks to the advent of the laser video disc, and Australia's video pirates have been acknowledged as the 'best' in the world...

by BARRIE SMITH

At a 1986 anti-piracy conference in London, Australian video pirates were recognised as the 'best' in the world. But questions of 'quality' aside, 1984-5 saw bogus tapes represent 25% of all movie tapes sold and rented in Australia — stripping legal video operatives of $30 million in revenue. Since then matters have settled down somewhat: in 1992 illegal tapes accounted for 5% of the legal trade, with the latter estimated to be worth around $240 million. Unfortunately for Hollywood, technology has now opened another door to fuss-free, high quality illicit tape dubbing: the easy, world-wide availability of video laser discs and players.

Pirating video cassettes of movies is a risky business, driven by two forces — the ferocious competition in the tape rental business and the conflicting release dates in the US and Australia.

Some rental shops are forced to hire out recent movies at anything down to 50 cents per night, with top of the line 'product' barely justifying a price tag of a dollar or two. Economic factors force many to indulge in back room piracy.

The film *Terminator 2* saw American cinema release in July 1991, but Australian audiences had to wait until September to see Schwarzenegger strut his stunts.

By December the US saw video discs on sale — and, soon after, pirate VHS tapes popped up in Australia.

The pirate tapes were made from laser discs, imported from the US, carrying high quality vision — in the NTSC video standard — and digital stereo sound of CD quality.

The actual act of importing the discs does not contravene Federal or State regulations, but once a disc is shown to an audience or traded — or copied — the weighty hand of the law begins its downwards descent.



The Australasian Film & Video Security Office's Steve Howes — an ex-English cop — holds the video disc of the movie 'Edward Scissorhands' which saw rapid release onto tape — via piracy.

For a start, the Trade Marks Act is contravened by the importer; the illicit dealer has no commercial rights to use of the film-maker's trade mark; the disc and illegal tape would not carry a censorship grading; and, of course, making a copy on tape breaches the Copyright Act.

Sydney office set up

In 1982 Hollywood interests set up an office in Sydney to control video piracy. Its headquarters are in the Sydney beach suburb of Mona Vale. Known as the Australasian Film & Video Security Office, its director is ex-English cop, Steve Howes. Finance for the operation is supplied by the Motion Picture Association of America (MPAA), the Motion Picture Export Association (MPEA), trade organisations representing such companies as Paramount, Universal, Fox, MGM, Warner, Disney, Columbia and others.

"In 1982 piracy was just becoming a problem in Australia", Howes explains, "and it increased through the years as the population of VCRs also rose".

"By 1985 approximately a quarter of the movies available were in pirated form. That piracy also included what we call 'bootleg' product — tapes brought in from Fiji, Singapore, Malaysia — films which hadn't been released on video cassette in Australia."

Prior release of a movie title naturally affected the tape rental business, becoming a "huge problem and a multi million



A sample array of seized pirate tapes. Note cutting dies (centre of picture) used to counterfeit security stickers.



Which is the genuine article? If can often be hard to tell the difference, but in this case the original is at right.

dollar loss to the Australian industry". Howes added that one of the major drawbacks was the Australian Copyright Act's impotence. Fortunately — for Hollywood — the opening of the office led to lobbying of the Government and a toughening of the Act, making proof of copyright easier.

1980's piracy methods varied. The simplest scheme was to hook up a pair of VCRs, load the 'master' and a blank tape — and press 'record'. Upper-level pirates managed to acquire high quality tape masters on 1" and 3/4" tape and used sophisticated processing hardware to maintain the quality level. The labels or 'slicks' were made by printers working from originals, employing mainstream reproduction methods — colour separations, etc. Often the copy was better than the original, with microscopic inspection of the label being the only way to identify the bogus copy. Occasionally, actual films were used for the copying process, with hand-written labels sufficing for identification.

In Australia there have been only two or three cases of such sophisticated piracy: Stallone's *Rambo* was one of the targets. US pirates, however, displayed considerably more vigour: the film reels of *Return of the Jedi* were seized at gunpoint from an armed guard whilst in transit from America to Canada. The George Lucas movie was tracked to London, then Amsterdam — where it was mass-duplicated — finally arriving in Australia two weeks later, for another film-to-tape dubbing session.

As the 1990's get under way piracy methods, via laser disc, are dramatically simpler. For around $2000 a counterfeiter can set up shop with laser player and VCR deck; US NTSC-format discs of top movies may cost around A$40-50 landed here; the colourful eye-catching slicks can also be copied on colour laser copiers delivering near-perfect reproduction.

Consumers rebelling

While technology is aiding the pirates, it is evident the consumer is rebelling. From a nation of dubbers we appear to have progressed to a society of dobbers: 99% of offences are uncovered when a member of the public rings Mona Vale.

Howes explains: "They've hired a video cassette, find the tape is unwatchable and feel annoyed because they're not getting the genuine article."

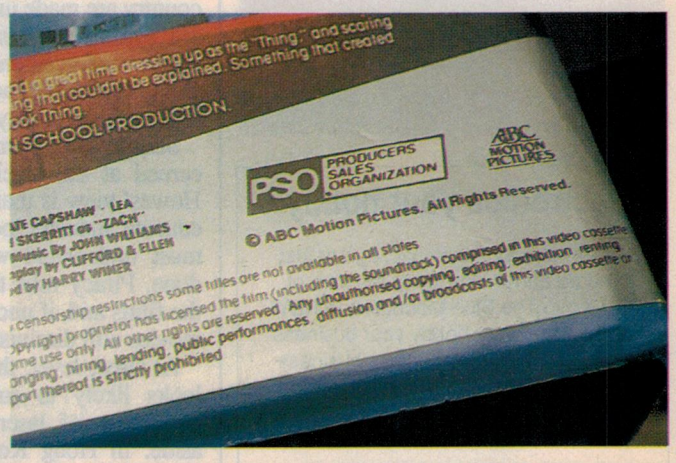
From 400 outstanding complaints on file, probably only five will go to law, the remainder being dealt with by warning or civil litigation. Fines have topped the $60,000 mark and involve confiscation of both tapes and equipment. The maximum penalty that can be given is $1500 per cassette up to a maximum of $50,000 per offence or five years in gaol.

The closing half of 1992 was a period of high activity for the AFSVO investigators:

On September 30, a caravan park electrician faced Port Kembla Local Court on 10 charges of stealing tapes from a video store and substituting them for pirated copies. (In a practice known as 'cookie swapping', the person hires the



Two recent movies targetted by pirates. Ninety nine percent of offences are uncovered by the general public phoning Howes' office.



The quality of video copying itself is so high that lack of definition in printing of the cassette 'slicks' (labels) is often the only way to detect bogus tapes.

Video pirates

video cassette, goes home, makes a copy, undoes a few screws, takes the original tape out of the casing and substitutes the copy. He then loads the legal tape into a new casing, which he keeps. He's swapped the 'cookie', and the shop ends up with the counterfeit.)

On October 19, a Cabramatta watch company owner incurred a penalty of $3500 and forfeiture of illegal tapes. An average of three retail stores are raided each month.

On November 12, a Surry Hills home movie company was fined $2000 and 300 laser discs confiscated when it was found the latter had been hired out without appropriate censorship markings.

Straight piracy is just one of the contraventions, both in legal and commercial terms. Howes noted that a cinema in Whyalla, SA faces closure because of laser discs. The local retailer has been selling discs of current release movies in NTSC format and pre-empts the cinema's release dates, leaving the cinema's owner with no audience. In a small town the laser disc often arrives before the film does.

Film ratings are a factor: An Adelaide woman hired a movie on disc — rated G — to watch but when she played it at home she thought the rating should have been higher, because of its violence. The actual film had been rated G in the US, but its Australian rating — if it had carried one — would have been PG. As Howes explains it "although the product itself is a legitimate one, it's being used illegally. There's royalty payments, licensing agreements and censorship".

Howes goes on: "If discs are brought in by the licensee — e.g., Columbia or Village Roadshow — they must pass censorship or be declared identical to the VHS tape. A rating is given and a label fixed to the disc".

Copyright tricky

Copyright can be a tricky area. In Australia the act of making a film establishes copyright. The international symbol © should be shown — but this is not compulsory.

"A lot of the problems appear when the films are actually made", Howes stated. "You may have a director, writer and a company who have all put money into the production, with each claiming some rights. So it gets a bit confusing."

The range of counterfeit product is surprising. Once, only the popular titles found their way into the pirate lists. Now it can be anything people want to hire. These include so-called 'top ten': *Dracula*, *A Few Good Men*, etc; B movies and 'art' films are increasingly pirated — offenders copy these thinking the investigators won't be interested. "But this is not true", Howes stresses. "As far as we're concerned, it's an offence and that's it."

Pirate activity is also present in sectors of the ethnic community — particularly in Melbourne. According to Howes a huge piracy industry operates within the Chinese community. Films from that country are made under a different licensing system to Australia's, making anti-piracy enforcement difficult. However China recently joined the Berne Convention, so matters may change.

Should the average person be concerned at the level of piracy? Director Howes' view is that "it's all very well to educate industry people, but the public must understand what damage can be done. Piracy robs the people who make the films and, if unchecked, the quality of movies will diminish".

At street level, the rental industry also looks likely to suffer from the rising popularity of laser video discs, piracy aside. In Hong Kong, the bewitchingly shiny platters have killed off the tape rental sector and are slashing into cinema takings. Disc players in that duty-free port cost less than $300. Laser copies of first run movies were landing within 48 hours of their US release — and well ahead of cinema showings. Stateside, tape and disc copies hit the shelves only 3-4 months after domestic cinema dates, and well before international release.

Why not synchronise?

The obvious question is why doesn't Hollywood get its act together and synchronise movie premieres on a global basis?

The answer, as with all marketing exercises, relates to timing. A film designed to attract cinema patrons in the middle of a US summer would 'die' if shown in an Antipodean winter; similarly with movies aimed at school holiday audiences.

Costs also come into it: to release a film everywhere in the world simultaneously, in both the cities and provincial towns, would require an enormous number of prints. So we may see piracy continue, if not flourish for a considerable time yet...

Postscript: Soon after Steve Howes was interviewed for this article, he headed off for Taiwan — to head the Taipei office. If he's looking for pirates, he should have a field day in the island nation! ❖

Is home taping illegal?

Are you breaking the law when you set your VCR to record *Gone with the Wind*? Are *you* a pirate every time you tape off air?

According to Section 111.1 of the Copyright Act, *The copyright in a television broadcast, insofar as it consists of visual images, is not infringed by the making of a cinematographic film of the broadcast, or of a copy of such film for the private and domestic use of the person by whom it was made.*

In other words, if the copy is made for sale or hire, or further broadcast or to be seen in public, it would infringe copyright. But the basic copying is not an infringement.

However Section 86, headed *Nature of Copyright in Cinematographic Film*, states it is the exclusive right of the copyright owner to make a copy of the film.

Which means you are allowed to make a copy of a film for private purposes — not to be loaned or sold outside the home — but the copyright owner still retains the right to prosecute.

Has that cleared the matter up for you?

How can you detect a pirated tape?

Poor picture quality of the videotape is not necessarily a sign — a legal tape can undergo hundreds of showings, and become worn. However, become suspicious of poor picture and sound quality and submit the tape to expert examination.

If you think you've found a counterfeit tape and wish to report it, contact the Australasian Film & Video Security Office, PO Box 515, Mona Vale 2103; phone (02) 997 8011.

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READER INFO NO. 2

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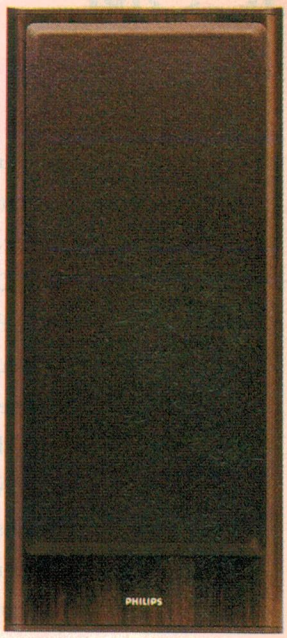
L.L. BROWN ADVERTISING 3907

READER INFO NO. 3



Video & Audio: The Challis Report

For this month's review, Louis Challis had the opportunity to test a very innovative system developed by Philips, which combines state of the art digital signal processing and distribution techniques with an active speaker system. His findings are very interesting, and suggest that this type of system may well form the future for high quality domestic audio reproduction.



PHILIPS' DSS 930 DIGITAL SPEAKER SYSTEM

The word 'digital' conjures up different images and meanings in one's mind, depending on your age, your interests or your profession. As a child I had the clear impression that the word 'digital' meant fingers, and I am still painfully aware that to most doctors it relates to gloved inspections of a patient's nether regions.

Over the last 15 years the word has conjured up exciting images to *EA* readers, of a new technology that is turning the fields of commerce, industry and electro-acoustics on their veritable ears.

When the first CD players entered the marketplace, Philips International, with the support of Sony International, trumpeted fanfares which were literally ringing in our ears, even as we listened to the first generation of CD players.

As many of you are by now aware, that generation of CD players displayed insidious (if not downright nasty) ringing characteristics which the developers had clearly not foreseen, nor understood, and which ultimately led to a new generation of CD players with appropriate oversampling and vastly different filters to obviate their audible deficiencies.

Hot on the heels of those CD players in the early 1980's we were offered digital audio tape recorders (DAT), which I still find exciting; also Yamaha's development of DSP chips and sound processing concepts, which also set the Japanese and American computer industries on their ears.

During that same period, we were astounded by sales of computers with innovative and exciting digital sound recording capabilities, which more significantly offered the ability for computer whizzes to control and orchestrate an unbelievable range of external musical instruments and digital sound processing equipment through the aegis of MIDI interfaces.

Then during the last year or so we've seen the introduction of recording CD players, Philips' DCC recorders and players, and last but not least, Sony's Mini Disc system, which is now apparently to reach Australia in September.

All these remarkable developments and their impact on our society, have occurred in the remarkably short span of 10 years — starting in the early 1980's, at a time when much of the western world was riding high on an economic boom. As we now painfully know, that boom has been followed by a disturbingly deflationary bust, which in turn deflates our ability to purchase new technology, and for many imposes even greater hardships than that.

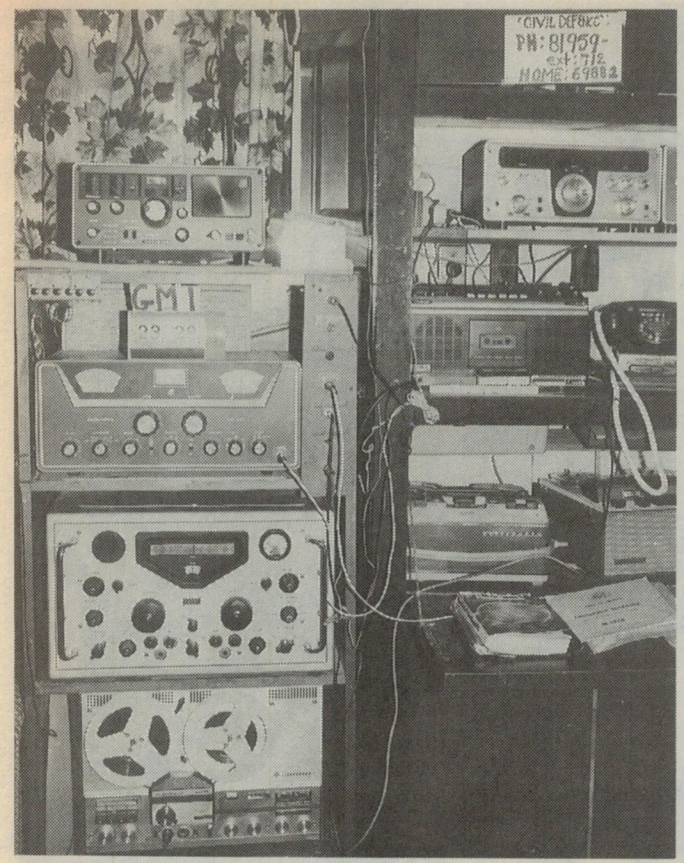
The concept of 'digital speakers' must appear logical to their developers, and particularly to Philips who have consistently led the pack in development of new technology, from the time when the company started manufacturing light bulbs a century ago. Even so, this subject needs to have a bit more light added to it, and hopefully this review will shine this further light on a product and a subject which warrants a closer inspection, and more visibility.

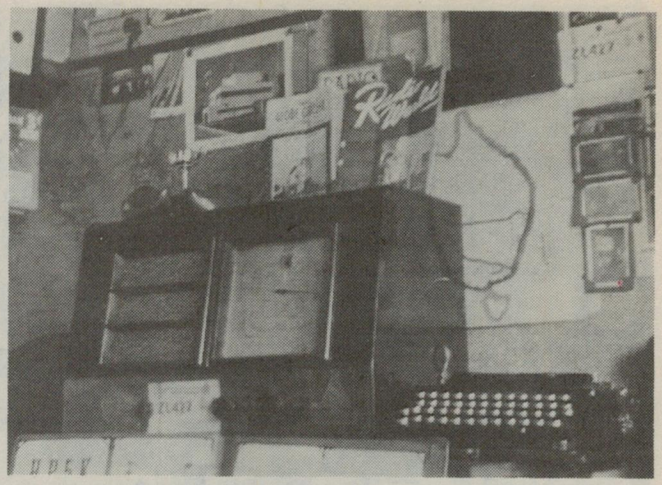
First glimpses

I had my first glimpses of the new Philips digital speaker technology, and a relatively brief opportunity to hear it, at the Winter CES in Las Vegas 18 months ago. At this same time I noted that Philips' press releases claimed attributes and performance characteristics for the new digital speaker technology which made the multi-functions of a 'Swiss Army Knife' look *passe*! The releases at the Winter CES proudly claimed that the DSS 930 system 'is one more example of Philips' aggressive efforts in applying digital technology', and went on to claim:

The DSP circuit, one of the most powerful available, offers several significant benefits including: extended flat frequency response, digital phase compensation, and the elimination of crossover errors. In addition, Philips engineers are able to effectively adjust every element in the system, resulting in superior sound. In normal analog speakers, the frequency response typically drops quickly below 100Hz. By adjusting and compensating for the natural deficiencies of the speaker, the DSS 930 achieves a +/-0.5dB at 40Hz - 20,000Hz frequency response, far exceeding analog speaker capabilities.

As if that weren't enough, the release went on to make further claims about the ability of these speakers to precisely split the component signals; that the digital crossover would remove all traces of crossover non-uniformity, (the interaction notch in the frequency response); and that the resulting





Above: This Ekco receiver manufactured by E.K. Cole Southend-on-Sea, UK was used for listening from 1939 - 1954, and is an excellent example of an early valve receiver.

Left: The writer's listening post includes in the left cabinet an FRG-7, a Hallicrafters SX122, the Racal RA17, a Telefunken recorder, and on the right an Allied SX 190, Aiwa multiple band cassette radio and two other recorders. The six pushbutton controls under the FRG-7 feed the aerials to the receivers while the plug board in the centre of the photo carried the programmes from the receivers for recording purposes.

was a major selling point with customers, indicating the cities that could be tuned to on this Ekco receiver.

Calibration was fairly accurate, the mediumwave band was cut into two and the shortwave band extended continuously up to 30,000kHz. I still have this receiver, with its beautiful walnut cabinet and it still takes an honoured place in my receiver line-up.

In 1954 there were many war time receivers available on the market and I started with a Hallicrafters SX28, to be followed in 1959 by a purchase of the Eddystone 840A communications receiver — a set that did untold hours of work in searching the dials for interesting signals.

I added a Hallicrafters SX122 to the range in 1964, and later in 1970, a Racal RA17, which is the only tube receiver I still use regularly at my listening post.

In 1978, a friend introduced me to the McKay Dymek, which is excellent for a blind listener — using it, I could find frequencies quickly and accurately for the first time.

Though it was not designed for visually impaired listeners, the large digital readout was controlled by four knobs — the one on the left in 10MHz units, then 1MHz units, then 100kHz units and then finally units of 5kHz. Fixing a raised strip on part of each knob from the centre to the outside of the rim, I could find frequencies using the old '12-hour clock system': when all the knobs were pointed upwards, all frequencies would be zero. The most difficult control of the lot is the end one on the right, because there are 20 positions on the knob which gives you frequencies from 0 - 95kHz.

The McKay Dymek indeed gave me independence, but little did I dream of Sony's introduction in 1980 of the keypad controlled, portable model ICF 2001. This immediately gave me tremendous independence and I had three in operation in a short time. One is my bedside listening and monitoring radio, and it is still there today after 12 years — with no maintenance whatsoever.

Then the whole market changed to keypad radios and so in 1987 the Voice of America loaned me the popular Sony ICF2010 or 2001D. This is still used today as the main monitoring receiver and, as instructued by Sony, a short 'inverted L' aerial is used for the reception of all incoming signals.

The Philips DR2999 was added in 1989, so that I now operate all keypad or receivers adapted for my own listening — except for the Racal.

Presentation

Over the 40 years, the style of presentation has changed. The amount of information being received has expanded rapidly because in 1952, one was dependent almost entirely on one's own listening.

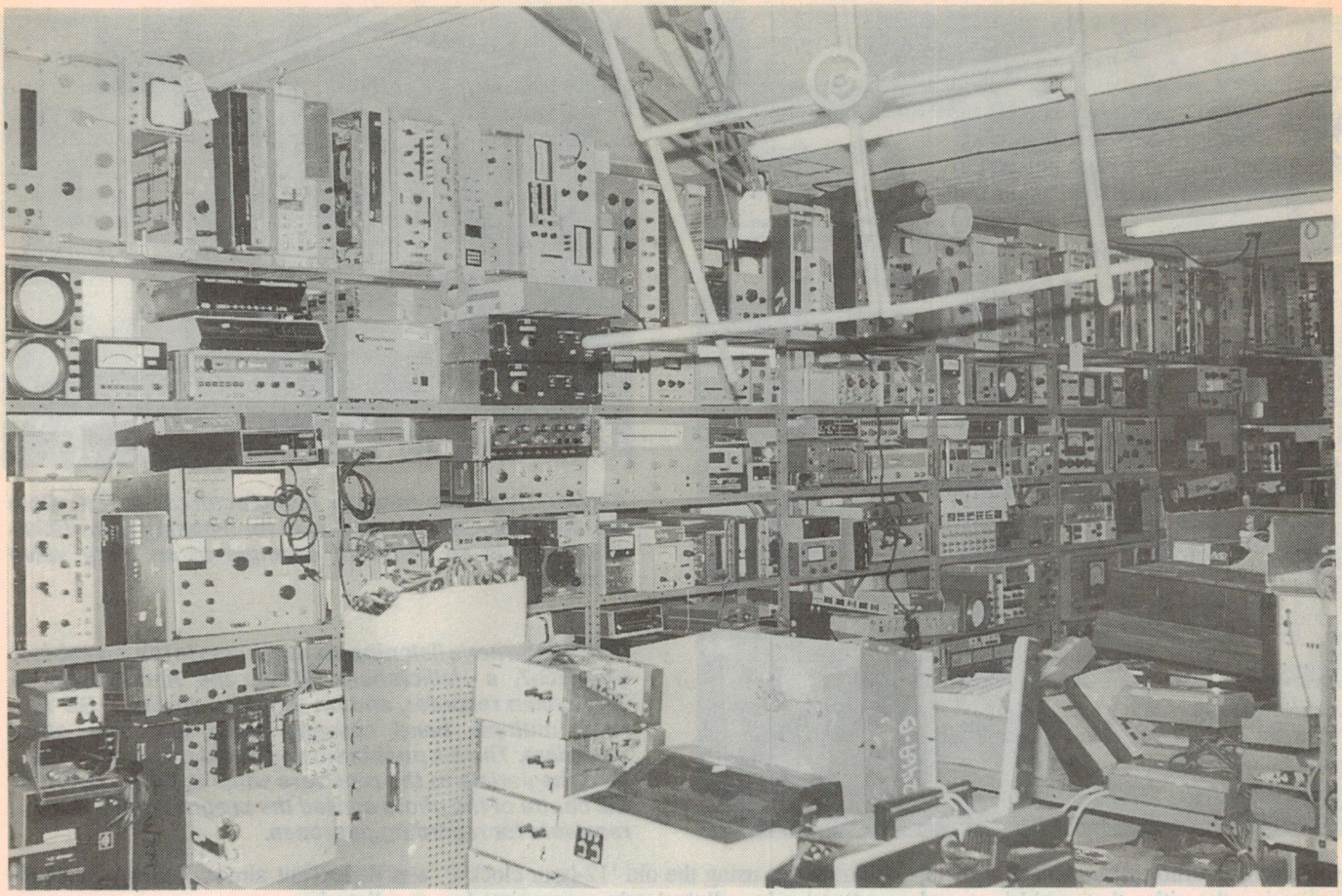
The first DX programme started in 1948 from Radio Sweden but over the years since then, most international broadcasters have introduced specialised programmes for shortwave listeners. So news is available quickly and from a wide area of the world.

The speed in getting material onto shortwave broadcast sessions has also improved. For 30 years I visited the local RNZ sation 4ZA, with my Braille script and reels of tape.

Studio recordings were made and the tape was then flown to Holland. There the programme was put together and flown down to Bonaire, for broadcasting — so that there was almost a month between the time of recording and broadcasting. Today, with the satellite links between Bonaire and Hilversum, there is no delay as programmes are broadcasting simultaneously from Holland, Bonaire and Madagascar.

Today, Jonathon Marks from Radio Nederland or Tony King from Radio New Zealand International can phone me for an interview segment and within hours the programme is being broadcast. This leads to a very quick turn-around of news which makes for a minimum delay between recording and broadcasting.

We've come a long way in the last 40 years, haven't we? ❖



Tom Moffat discovers 'Experimenter's Heaven':

THE ULTIMATE DISPOSALS STORE

On his recent trip back to the USA to visit his family and look up old friends, Tom Moffat discovered what he claims is the closest thing to Heaven for a true-blue electronics experimenter: the ultimate disposals store, hiding away in Albuquerque, New Mexico. We finally stopped him drooling long enough to write this short report...

Yesterday I was at my local parts supplier's, rounding up the raw materials for a big run of kits. But I couldn't get served. Everything had come to a stop to help a man with a problem. He wanted a valve, a 12AX7, to get his cranky old valve-based stereo amplifier going again. This fellow was one of those who shuns the new solid state stuff — to him (and many others), valves sound best. Until you have to buy one...

Twenty years ago you could walk into any parts supplier in the land and say "A 12AX7 please", and you'd have it in your hand in seconds. But in modern times... first it was necessary to decide what the 12AX7 actually did (a high-gain dual triode) and then to work out its English type equivalent (was it an ECC81 or an ECC83?).

The current generation of technicians, and shop assistants in electronics stores, were brought up and educated after valves were well and truly dead. But in this case, the proprietor of the shop had recently completed an electronics course at Hobart Tech at which a grounding in valve technology was still given. So he knew what his customer was on about, at least.

Finally, after digging through heaps of catalogs, 12AX7's appeared — 13 in fact. The last 13 in Australia, held by a company in Sydney. The deal was done, and the amplifier was given one more lease on life.

But had this fellow lived in Albuquerque, New Mexico, in the USA, he could have had his 12AX7, or nearly any other valve (tube) for that matter, straight over the counter.

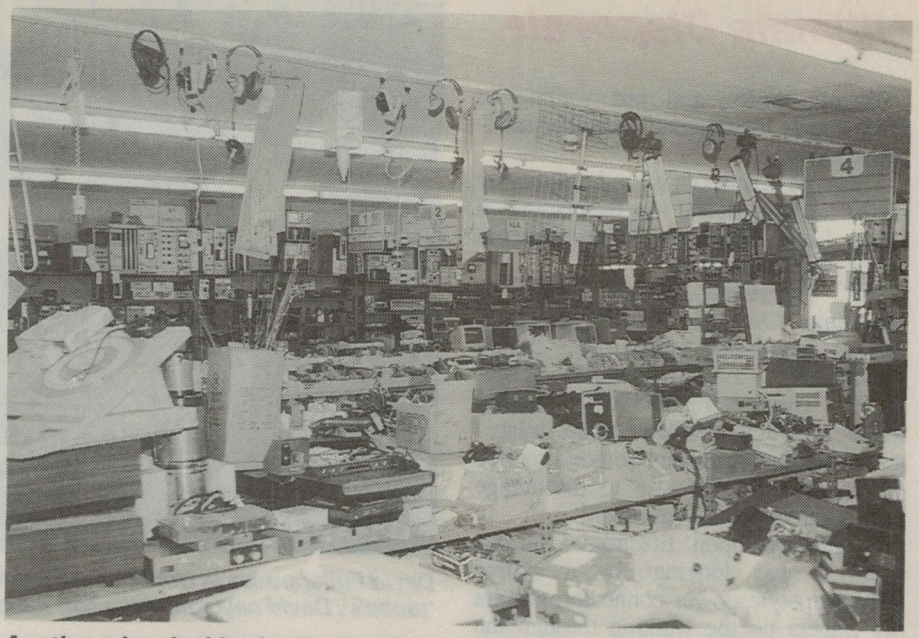
How about a matched pair of 6L6's for $25? There is still one place that keeps the slow-moving electronics stuff, as well as most anything else a dedicated experimenter would require.

Electronic Surplus is conveniently situated just outside the main gates of Kirtland Air Force Base, home of Sandia National Laboratories.

Sandia is best known for its weapons research, including Star Wars programs, but it's also getting into such things as automatic lens correction for astronomical telescopes, and efficient batteries for electric cars. Sandia's game is research and development, which means they're doing things that need equipment that doesn't exist. So they build it. Or if they buy stuff, it's only the best brands available.

When I worked at Sandia back in the sixties, there was one employee perk that was pure heaven for radio hams and other experimenters — the salvage yard. Here all the massively expensive equipment built or bought for research projects was disposed of when the project was finished; usually sold off by weight at so many dollars a pound. The salvage yard was open to employees every day during the lunch hour, from 12 to 1, and it was a gold mine.

You could walk around with a bag in your hand and grab a couple of handfuls of the very best Allan-Bradley pots, or Cannon connectors, or resistors or capacitors. Going through the checkout, your bag was weighed, and you handed over a couple of dollars for some as-new stuff that would have cost the government thousands.



Another view inside the Electronic Surplus treasure trove. While to some it probably looks like 'a jumble of junque', to any true blue experimenter, there are all manner of interesting and useful gadgets...

There were occasional pieces of complete equipment, but usually items were stripped down and the parts sold.

There was intense security at the time, and it was assumed that clever buyers could figure out what a particular custom-made instrument did, and thus what kind of a research project it was used in. An exception to this rule was power supplies, which almost always made it through the salvage yard intact, complete with their lovely Triplett or Weston panel meters and engraved front panels. Something like this might cost you ten bucks.

Ah, those were the good old days. There was no part you couldn't get. But those times haven't gone completely. In Albuquerque, at least part of what used to be the salvage yard has now been privatised, commericalised, civilised, and opened to the public in a shop called Electronic Surplus.

On the walkway outside the store is a grand collection of equipment racks, stripped of their contents, and for sale. The things that came out of the racks are inside.

The walls of Electronic Surplus are lined with shelves containing every type of electronic instrument, both custom made and off the shelf.

The custom-made gear is of the usual sparkling Sandia Labs quality, and the off-the-shelf stuff carries names like Tektronix and Hewlett-Packard. Most of it isn't the latest technology, so things like power supplies still have analog meters, now the beautiful rectangular ones, flush mounted in their engraved panels in black metal frames. Yum!

The central part of this store is jammed with trestle tables holding boxes of parts — obviously some of the instruments are still being stripped down.

Even the ceilings have goods on display... in one place a big row of headphones, and in a prized position (see opening photo), a commercially made Lindenblad antenna from one of Sandia's missile test ranges.



Lost in a sea of old computer monitors, record turntables, equipment racks and old telephones, a lone experimenter explores an item of interest.

Ultimate Disposals

Twenty bucks, and just waiting to feed signals to someone's weather satellite receiver.

This type of antenna is used extensively on the test ranges, and was the inspiration for the Lindenblad construction project in *EA* of August last year.

Not everything in the shop is electronic. On one table I spotted a pile of brand new metal signs saying 'DANGER — EXPLOSIVES — KEEP OUT!'. These were obviously intended for the perimeter fence of some isolated test range, but one could do good service on your own front gate to discourage visits from unwanted salesmen!

I stumbled upon Electronic Surplus when I was looking for a simple Walkman-style power connector, and let my fingers do the walking through the local Yellow Pages. No problem, an electronics store, not far away, but... little Japanese connectors are not the sort of stuff Electronic Surplus deals in; their game is disposals.

They referred me to the nearest Tandy store for the connector. However before leaving, I did manage to score a 100pF variable capacitor — just right for a transmitting antenna tuner.



David Fuller poses in front of the Electronic Surplus racks of old valves — sorry, 'toobes'. David says his store can handle mail orders from Australia.

Now where else in the world could you walk into a shop, off the street, and end up with one of those! Looking back on it I should have grabbed one of those EXPLOSIVE signs too...

This is not meant to be a free plug for the place, but David Fuller (the young fellow with the valves) says his store is prepared to handle mail order business from *Electronics Australia* readers, by negotiation. If there's something you need, but just can't get locally, a letter to him might bring unexpected joy.

You can write to Electronic Surplus, 9012 E. Central S.E., Albuquerque, New Mexico, 87123 USA. Their phone number is (505) 296-6389.

Tell them you heard about it from that guy with the camera who blew in from Tasmania! ❖

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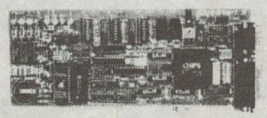
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Intended for professional service and repair technicians, Service Diagnostics is also *easy to use* for the novice. Clear, concise on-line help and intuitive menus make finding system problems a breeze. Tests all CPUs, math chips, all memory, floppy, fixed and non-standard disk drives, standard/non-standard printers, system board, video, com ports and all keyboards. Utilities include low-level reformat, log bad sectors, edit bad sector table; the partition editor allows you to set up multiple partitions; *back-up program* transfers hard disk image on unformatted floppies and allows for *restore* after reformat.

Ideal for UNIX and other operating systems, the *self-booting version* doesn't require DOS. The manual offers troubleshooting tips to the component level. Also available in a complete Kit including; all CPU specific software, dual size floppy alignment software (see Alignit), and PC/XT & AT ROM POSTs. ***Winner of the PC Magazine Editor's Choice Award in August 1990.***

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READER INFO NO. 5

Projecting essential flight data onto glass within the cockpit, this "Head Up Display" enables F/A-18 pilots to keep their eyes in the sky. This is typical of the leading edge technology the Air Force is involved in.

So when choosing Year 12 students to be accepted for a degree in Electrical Engineering at the Australian Defence Force Academy (ADFA), naturally they have to be leading edge too.

In fact, even to qualify you'll need to be in the top 20% of Year 12 students (and aged over 17 and under 20 as at January 31st, 1994). But then, when you consider the rewards, it's not surprising that Air Force selection for ADFA is so competitive.

For a start, you'll be paid to study in one of the best equipped engineering facilities in the country. $12,216 in your first year, increasing to $19,498 in your final year.

You'll encounter demanding physical and military training which will give you leadership and management skills you just can't find in other tertiary institutions.

And when you graduate from ADFA you'll have a highly recognised degree and the rank of an Air Force Officer to match. (Not to mention 60 days of approved practical engineering experience.)

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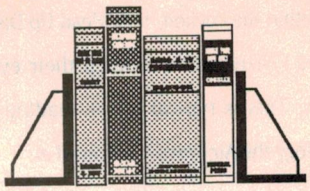
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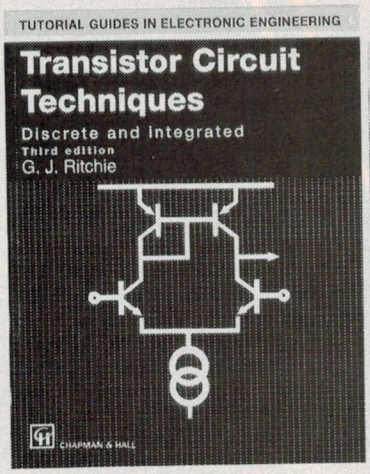
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NEW BOOKS



Circuit design



TRANSISTOR CIRCUIT TECHNIQUES, 3rd Edition, by G.J. Ritchie. Published by Chapman & Hall, 1993. Soft cover, 244 x 190mm, 224 pages. ISBN 0-412-464705. Recommended retail price $44.95.

Aimed at the first year undergraduate student, this book gives a good introduction to the analysis and design of electronic circuits. To assist with the understanding, the author gives several design examples, including all necessary mathematical analysis (based on simple DC and AC models) for the common semiconductor devices. Each chapter includes a list of revision problems, with solutions at the end of the book.

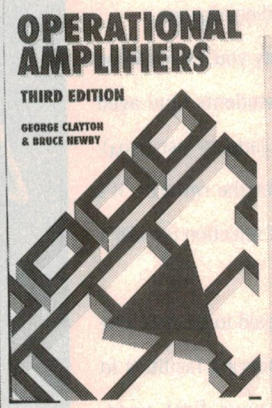
The nine chapters cover the essentials of transistor circuit techniques, with emphasis on discrete components, but also covering integrated ones. Following an introduction to semiconductor devices, and to amplifiers and biasing, three chapters are devoted to bipolar junctions transistors: BJT models, single-stage amplifiers with feedback, and switching. Another chapter covers Field Effect Transistors (FETs).

The remaining chapters cover linear integrated circuit techniques, audio power amplifiers and power supply regulators. The last two of these topics are new to this third edition of the text.

The book is well set out, clearly illustrated, and the examples and problems ensure that the student understands the relevant concepts. I found it to be a very good text to introduce anyone to a sound foundation, both in concept and design approach, for understanding modern electronics.

The review copy came from Thomas Nelson, 102 Dodds Street, South Melbourne 3205. It should be available from technical bookshops. (P.M.)

Op-amp basics



OPERATIONAL AMPLIFIERS, Third edition, by George Clayton & Bruce Newby. Published by Newnes, 1992. Soft cover, 215 x 138mm, 559 pages. ISBN 0-7506-0640-1. Recommended retail price $75.95.

This expanded third edition is intended to serve as a useful text book for students, or a reference for practising engineers. The practical orientation of the book is especially obvious in the last three chapters of the book which cover Instrumentation Applications (interfacing transducers to op-amps), Active Filters, and Practical Considerations.

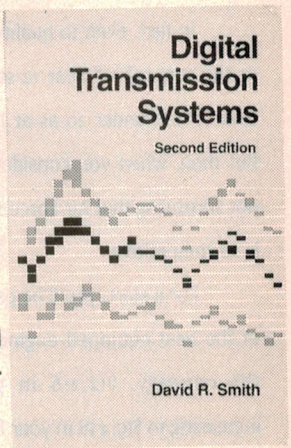
The first seven chapters give a thorough coverage of the basics of operational amplifiers: the ideal op-amp model, op-amp performance parameters, measuring these parameters, and applications of op-amps: scaling, nonlinear circuits, integrators and differentiators, and switching.

The text is extremely well illustrated with circuit examples, performance graphs and mathematical derivations. Each chapter has several exercises (answers are given at the end of the book) for the student to check their level of understanding. The theory of op-amps is covered extensively.

But, as mentioned above, the book emphasises practical applications. The chapter on Practical Considerations gives many areas where practice differs from theory, while Appendix A1 gives 27 examples for op-amp circuit ideas. Other appendices cover 12 different types of instrumentation transducers (strain gauges, thermistors, etc.), and list a range of Texas Instruments and Motorola op-amp data sheets.

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Digital systems



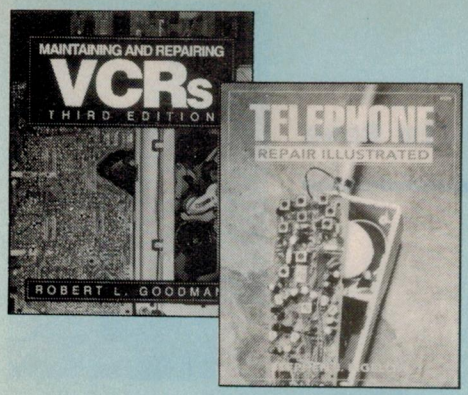
DIGITAL TRANSMISSION SYSTEMS, by David R. Smith. Published by Van Nostrand Reinhold, 1993. Hard cover, 235 x158mm, 818 pages. ISBN 0-442-00917-8. Recommended retail price $175.95.

The intended audience of this book includes: engineers involved in development and design; system operators involved in testing, operations and maintenance; managers involved in system engineering and planning; and instructors of digital communications courses. It aims to provide insight into state-of-the-art digital transmission systems through a practical approach.

Its 13 chapters cover the background and principles of digital transmission systems, A/D conversion techniques, time-division multiplexing, baseband transmission and digital modulation techniques. Various systems are covered: cable, fibre optic and radio; as well as network timing, system testing and monitoring, and data transmission over the telephone network.

Each chapter is well set out and illustrated, with extensive references and problems. The book is a serious work on a specialised area.

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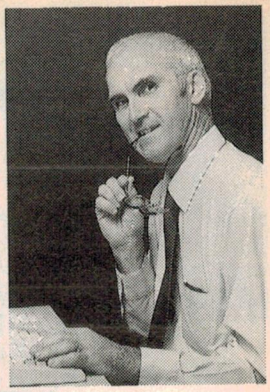
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FORUM

Conducted by Jim Rowe



Back EMF: it certainly keeps on generating letters!

Last month, you may recall, I published a selection of letters that had arrived in response to Arthur Comer's letter in the April issue, on the subject of 'back EMF' in inductors (and my own comments). Just as I thought the stream of letters on this subject had dried up, another bunch arrived — one from as far afield as the UK. It seems that Mr Comer may have touched on a fairly sensitive spot, for many readers...

It's beginning to look as if the subject of back EMF and its existence or otherwise is likely to be one of those that just won't go away — a bit like fancy audio cables. Try as I do to change the subject, so that Forum has a bit of variety and general interest, we seem to find ourselves getting dragged back into these 'hobby-horse' topics, time after time.

Still, I guess it shows that these topics are of great interest to certain groups of people, even if they are of limited (and perhaps fading) interest to the rest!

Be that as it may, though, since the back EMF hobby-horse seems unwilling to canter off into the sunset at present we may as well hop on again, and see where it takes us this month. Since we don't often get letters from readers in the UK, I'll let Mr Paul Coxwell have the first ride. He hails from Sutton on Sea, and his comments on the subject are quite interesting:

I was interested to read Mr Comer's letter and your reply regarding the back-EMF generated by an inductor.

I am in complete agreement that the term electromotive force applies to a part of a circuit which is supplying energy. This is also commonly referred to as a voltage rise, in order to distinguish it from a voltage drop which occurs when energy is taken from the circuit.

While I have no argument with Mr Comer's statement that the induced EMF generated when the supply is disconnected attempts to maintain a current flow in the same direction, I fully concur with your reasoning that the coil is now supplying energy so the polarity at its ends must be reversed. This can be confirmed very easily by connecting an oscilloscope across the coil: Assuming that the applied battery voltage gives an upward deflection of the trace, when the circuit is broken the spot will briefly deflect downward, below the centre line. Like you, I can see no logical reason why this induced voltage should not be called a 'back-EMF', especially since EMF is directly related to voltage rather than current.

There is one other statement made by Mr Comer that you did not mention in your reply. He states that if we apply DC to an inductor we do not generate any back-EMF. While I do not dispute the fact that the coil is taking energy from the supply in order to build up a magnetic field, it is not true to say that no EMF is generated within the coil.

As current starts to flow through the inductor, a magnetic field expands from each turn of wire. This field cuts across neighbouring turns, inducing an EMF in them which attempts to counteract the applied voltage. Since this induced EMF tries to force current to flow in the opposite direction, I wonder if Mr Comer would object to this being called a 'back-EMF'. Admittedly this EMF cannot be measured directly at the terminals of the coil, but nevertheless its effect is clearly observable; it is this induced counter-EMF that prevents circuit current from rising to its full value immediately upon connection.

These two sources of induced EMF in an inductor provide the device with one of its fundamental characteristics — to oppose any change of current, whether that change is an increase or a decrease. The first attempts to prevent an increase in current by generating an EMF of one polarity, while the second attempts to maintain current flow by generating an EMF of the opposite polarity.

I guess it is a matter of semantics as to how you can call both of these voltages 'back-EMF' or 'counter-EMF', so perhaps this is the problem that Mr Comer is addressing. In practice this does not seem to cause any confusion; I have written several texts on this subject and used both terms extensively, as have many other people.

Thanks for those comments, Mr Coxwell, and it's nice to know we're read by someone the other side of the globe, like yourself — and a textbook author, at that. I like your point about the generation of a counter-acting voltage in the inductor even when DC is applied, too — this must indeed be the explanation for the way the inductor current is zero initially, and grows exponentially. If there were no such counter-acting voltage, this surely wouldn't occur.

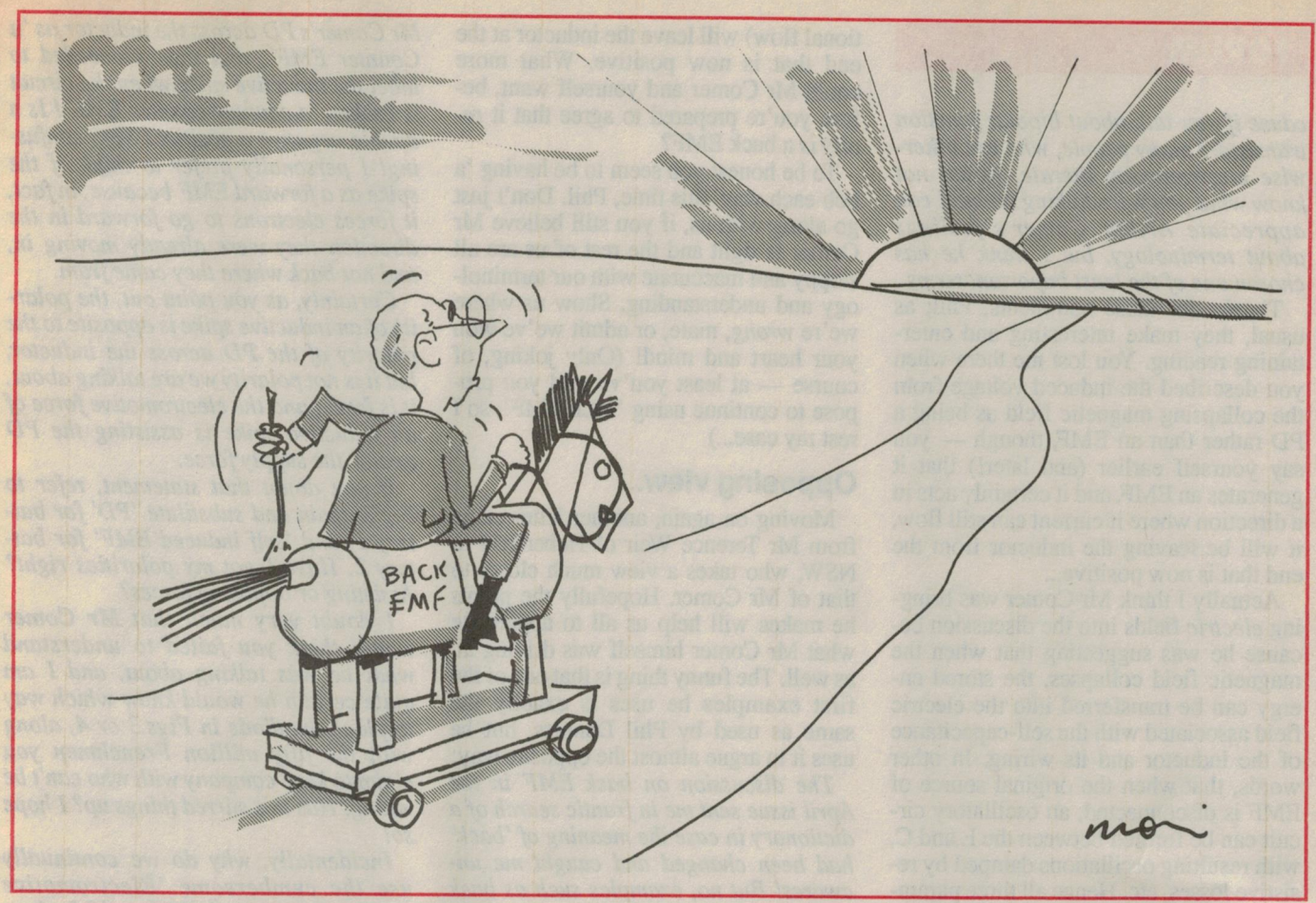
As you say, perhaps Mr Comer is merely quibbling over semantics — whether we should call this kind of induced counter-acting voltage a 'back EMF' or a 'counter EMF'. Or perhaps he just doesn't like using the term 'EMF' at all, in which case we might be able to make him happy by calling it a 'bucking voltage', or whatever.

Frequent contributor

Again, thanks for your contribution to the discussion. But moving right along, let's look at the comments made by our frequent contributor (adversary?) Mr Phil Denniss, of the Department of Plasma Physics at Sydney University.

Phil's comments came as part of a fairly long letter on a variety of topics, including (you guessed it!) fancy audio cables. I'll try to present the rest of his letter soon, but for the present we'll just look at the section in which he makes his comments about back EMF.

The subject actually seems to have propelled him into quite a lyrical mood, because he begins with a quote from that



classic Australian poem, *The Sentimental Bloke*:

"What's in a name" she says an' sighs,
And clasps 'er little 'ands an' rolls 'er eyes.
"A rose be it any uvver name
Would smell the same"

(With all due apologies to C.J. Dennis, no relation.) Gees, I am having trouble getting my pedantry worked up over Arthur Comer's views on back EMF (Forum, April '93). Who does he think he is anyway, trying to out-pedant me?! But I do have a bone to pick with him.

Arthur Comer claims (top of LH column, p.41) that '...the collapsing field becomes an EMF'. Wrong, the collapsing field ***generates*** *the EMF, it cannot* ***become*** *the EMF. He goes on: '...creating a large PD across the inductor until the energy in the electric field, plus resistance loss, equals the value $L.I^2/2$ at the instant the circuit is broken'. This is a confusing and just about meaningless statement.*

For a start there is ***no*** *'electric field' that needs to be considered, although there is a magnetic field. The energy in this magnetic field is always $E = L.i^2/2$ (where i is the instantaneous current in the inductor), regardless of anything else that happens in the circuit. The collapsing magnetic field will maintain a PD (albeit a falling PD) until the energy in the field is reduced to zero.*

Arthur Comer contends that this 'EMF of self-induction' is not a 'back EMF', since it maintains the original direction of current. I for one cannot see that the direction of current has anything to do with what type of EMF we have, especially as most of us seem to agree that all EMF's have the current flowing out of the positive terminal.

The whole issue can be quite confusing. Consider the humble torch battery — sorry, torch cell. Most of us agree that it is the source of an EMF. Suppose now that we have two of them, and we wire them in parallel, positive to positive and negative to negative. Now unless we are really lucky (or unlucky maybe) their EMF's will not be the same and we will get a current flowing equal to the difference in EMF's divided by the total circuit resistance.

Does this mean that one of the cells ceases to be an EMF? I suggest that the EMF is still there and is still pushing electrons out of its positive electrode, the problem is that the other cell is pushing more electrons into that same positive electrode, and all we can measure is the difference (i.e., the nett current)!

Let's go back to our relay. Suppose in the course of our day we come across a circuit as described by Mr Comer, with the switch open and a collapsing magnetic field in the coil windings, exactly as we might expect itt o be shortly after the switch was opened. The field could have been introduced by some source that we are unaware of, but the behaviour of the circuit would be the same in that we could measure the same falling PD at the terminals of the relay's coil. Can we confidently call this 'an EMF of self induction', or 'a back EMF'? I think clearly it would be an EMF, with the current flowing out of the positive terminal. It seems to me that the way we describe it depends more on the history of the circuit than the current flow.

For me, well I will continue to call 'a back EMF' 'a back EMF'. Until we can convince thousands or even millions of technicians, engineers, scientists, teachers, students, etc., that a back EMF is not 'a back EMF' then I think it would be best to stick with the term 'back EMF'.

It might not be exactly correct, in fact I think it is a bit of jargon — sort of colloquial — but at least we all know what we are talking about. Ask yourself why we refer to transistors and FETs, which are field effect ***transistors****. It is mostly be-*

*cause if you talk about bipolar junction transistors many people, **who are otherwise electronically literate**, would not know what you were talking about. I can appreciate Arthur Comer's feelings about terminology, but I think he has chosen one of the least important terms.*

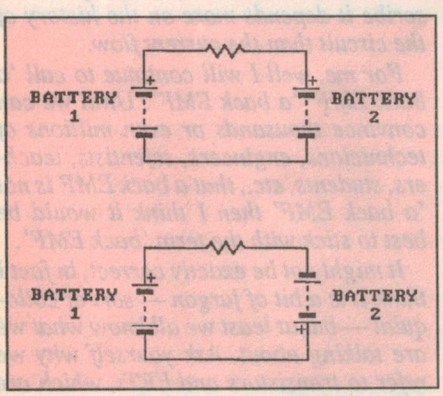
Thanks for those comments, Phil; as usual, they make interesting and entertaining reading. You lost me there when you described the induced voltage from the collapsing magnetic field as being a PD rather than an EMF, though — you say yourself earlier (and later!) that it generates an EMF, and it certainly acts in a direction where if current can still flow, it will be leaving the inductor from the end that is now positive...

Actually I think Mr Comer was bringing *electric* fields into the discussion because he was suggesting that when the magnetic field collapses, the stored energy can be transferred into the electric field associated with the self-capacitance of the inductor and its wiring. In other words, that when the original source of EMF is disconnected, an oscillatory circuit can be formed between the L and C, with resulting oscillations damped by resistive losses, etc. Hence all three parameters — L, C and R — must be taken into account in order to determine the peak voltage of the inductive 'kick'.

At least I *think* that's what Mr Comer was driving at; I'm not entirely sure...

As you say, it's all a bit confusing. I for one can't really see why *you* feel that the term 'back EMF' is 'sort of colloquial', for example. There doesn't seem to be any real argument that it's an induced *voltage*; or that it's associated with energy coming back into the circuit from the magnetic field; or that its polarity is the opposite of the original PD; or that if the circuit still provides a path for current to flow as a result of that induced voltage, that current (in terms of conventional flow) will leave the inductor at the end that is now positive. What more could Mr Comer and yourself want, before you're prepared to agree that it *really is* a back EMF?

To be honest you seem to be having 'a bob each way' this time, Phil. Don't just go along with us, if you still believe Mr Comer is right and the rest of us are all sloppy and inaccurate with our terminology and understanding. Show us where we're *wrong*, mate, or admit we've won your heart and mind! (Only joking, of course — at least you've said you propose to continue using 'back EMF', so I rest my case...)



Mr Weir's Fig.1 (top) and Fig.2 (above).

Opposing view...

Moving on again, another letter came from Mr Terence Weir of Haberfield in NSW, who takes a view much closer to that of Mr Comer. Hopefully the points he makes will help us all to appreciate what Mr Comer himself was driving at, as well. The funny thing is that one of the first examples he uses is exactly the same as used by Phil Denniss, but he uses it to argue almost the opposite way:

The discussion on back EMF in the April issue sent me in frantic search of a dictionary in case the meaning of 'back' had been changed and caught me unawares! But no, examples such as back pedal and back current etc. were given, and still seemed to mean reverse or opposing force. Whew!

What then is a back EMF? Surely one that opposes the supply force, or has that been changed? Here are two simple circuits (Figs.1 and 2)...

Q1: Select the circuit which has the EMF sources in opposition to each other.

Q2: In the circuit of Fig.2, could one of the batteries be said to be a 'back' EMF in relation to the other?

(Sorry, no prizes for the correct answers!)

It gets harder! Consider the two circuits given below. (Figs.3 and 4) *Do they look familiar? Have I breached copyright?*

Now: which of these circuits contain a back EMF? (or PD if that turns you on) You didn't pick Fig.4? Nor did I!

I think Mr Comer is quite correct when he states that "an EMF of self induction is not a back EMF". How can it be, when it is assisting the supply force not opposing it!

I rummaged through available textbooks but couldn't find one brave enough to call an inductive spike a back EMF — perhaps you could refer me to one for further reading. Interestingly however, I did turn up a copy of The Radio Amateurs' Handbook which referred to Mr Comer's PD across the inductor as 'a Counter EMF', and then proceeded to label the inductive spike when the circuit is broken 'a counter-counter EMF'! Is a double negative a positive? Very confusing! I personally prefer to think of the spike as a forward EMF because, in fact, it forces electrons to go forward in the direction they were already moving in, and not back where they came from.

Certainly, as you point out, the polarity of an inductive spike is opposite to the polarity of the PD across the inductor, but it is not polarity we are talking about, it is force; and the electromotive force of an inductive spike is assisting the PD and/or the supply force.

If you doubt that statement, refer to Fig.2 again and substitute 'PD' for battery 1, and 'self induced EMF' for battery 2. Have I got my polarities right? Assisting or opposing forces?

I doubt very much that Mr Comer would think you failed to understand what he was talking about, and I am quite certain he would know which way to place the diode in Figs.3 or 4, along with the fifty million Frenchmen you claim to keep company with who can't be wrong! Has this stirred things up? I hope so!

Incidentally, why do we continually use the cumbersome 'Electromotive force' and not simply 'Voltage'? Is there some subtle difference? The Oxford Concise is no use at all! It defines voltage as 'an Electromotive force'. How dumb can you get! Can anyone help?

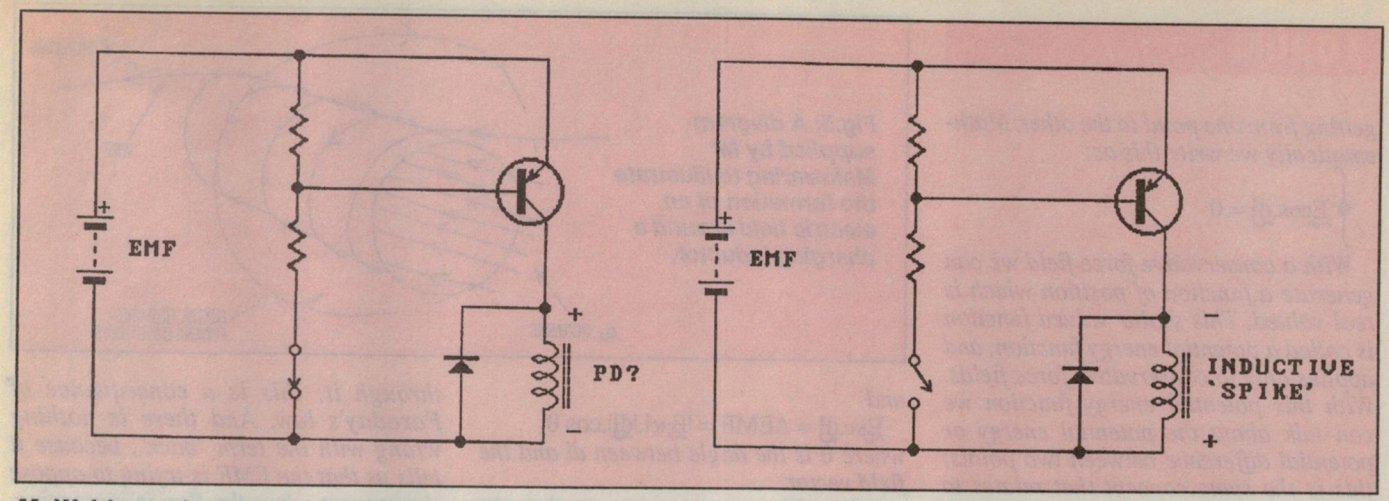
I enjoy reading your magazine, especially the Serviceman and Forum columns. Keep up the good work!

Thanks for your comments too, Mr Weir, although I must admit they did cause a certain amount of eye-rolling in this reader at least. It's amazing how different people can see the same thing in so many different ways!

Ringmaster rules, OK?

If I may be allowed to provide my own answers to your initial questions (and try stopping me — I am the ringmaster of this circus, after all!), I really don't want to call *either* battery in your diagrams of Fig.1 or Fig.2 a 'back EMF'; as Phil Denniss suggests, Fig.1 merely has two sources of EMF — one of which happens to oppose the other in terms of determining current flow.

In your Fig.2, there are again two sources of EMF, and this time they assist each other in determining the current flow. But this circuit is continuous, and thus not equivalent to that when we disconnect the original source of EMF as shown in my own Fig.2 in the April



Mr Weir's two further diagrams, Fig.3 (left) and Fig.4 (right) — both adaptations of my earlier example.

issue. So you really can't use the term 'back EMF' here, either.

Actually your circuit of Fig.1 is probably equivalent to the case where the inductor is producing an induced EMF to oppose the initial flow of current from the battery — as Mr Coxwell has pointed out. So if I had to call *any* of the EMF's in your first two diagrams a 'back EMF', it would have to be battery number 2 in Fig.1. (That wasn't really the answer you expected, though, I imagine!)

Sorry, I did pick it!

Now for your Figs.3 and 4. I'm sorry to disappoint you, but I *did* pick Fig.4 as the one showing a back EMF — after all, it's exactly the same diagram as my own Fig.3, in the April issue.

Nor can I agree that the 'EMF of self induction' is not a back EMF, because it is somehow 'assisting the supply force' rather than opposing it. You seem to be forgetting, as did Mr Comer I suspect, that the relay coil only generates its 'turn off' inductive EMF because *the original EMF has been disconnected* — i.e., it isn't effective any more, as far as the current in the inductor is concerned. So how can the inductive EMF be described as 'assisting the supply force', when the latter now isn't doing anything?

Frankly, if this is the only reason why Mr Comer and yourself don't want to call the induced voltage at turn-off a back EMF — simply because the direction it acts in, in terms of potential/actual current flow, doesn't 'oppose' the original flow (from the now disconnected battery) — I really think you've misled yourself.

The rest of us don't want to call it a back EMF for *that* reason, because to us this insistence on comparing it only with the now-disconnected battery really doesn't make much sense. We're happy to call it a back EMF simply because (a) it *is* an induced EMF; and (b) it certainly has the reverse polarity to the PD (or induced counter EMF, as Mr Coxwell would say) which is present across the inductor when the battery *is* connected, and trying to establish a current in the inductor.

I confess I really don't understand your point about the discussion being supposedly one of 'forces' rather than 'polarities', either. Surely the term 'back' implies a concept of direction, and you yourself ask why we all seem to be still using the cumbersome term 'electromotive force' rather than 'voltage'...

Perhaps you and Mr Comer will be satisfied if we all just scrap the old term 'EMF', and talk about 'back voltage'? Somehow I suspect not, but it's worth a try.

The big guns...

And finally, at least for the present, the last letter I'd like to present for your edification comes from Mr Alan Mainwaring, of Semaphore in South Australia. I've left Mr Mainwaring's letter until last deliberately, because in a way it represents the 'heavy artillery' — the serious mathematical/theoretical analysis, compared with the 'light weapons' we've all been using on the topic to date.

It's not exactly light bed-time reading, but I've decided to present it because Mr Mainwaring does make some thought-provoking points, for those who are able and prepared to follow him into the deeper regions of fundamental theory:

Many thanks to Mr Comer in raising the issue with regard to the concepts of potential difference and electromotive force. For many years I myself have tried to gain a clearer understanding of these terms, and have had not too much luck.

Many of the physics texts, even some of the better ones, do not seem to provide a really fundamental insight into the difference between the concepts of an EMF and a PD. But I believe I have found one text which seems to give the clearest insights; that text is 'Elementary Classical Physics' Volume 2, by Weidner and Sells, 1967. The vital information is contained in chapters 31 and 34, but be warned — it is not easy reading.

What I will try to do is show what are the essential features, via classical fundamental field theory, that distinguish between the concepts of a PD and an EMF.

Both concepts relate to an electric field. Both concepts also relate to the concept of work done by the electric field force. So, in what way are they different?

A partial explanation is that an EMF is associated with an energy source and a PD with an energy sink; but this is not the whole story. They are fundamentally different because of a fundamental property of any force field, of which the electric force field is a special case.

Taking the electric force field as a special case, if at any point we have an electric field vector, this vector can be considered to be made up of two parts. One part is a ***conservative*** *electric field, whereby the force field generated depends only on the relative positions of the electric charges and not on their velocities or accelerations. An example of a conservative field is a purely electrostatic field, due to fixed electric charges.*

The second part of the electric field is a ***non-conservative*** *force field, which is generated by accelerating electric charges.*

In a conservative electric force field, the work done by the conservative electric force through ANY closed path, back to its starting point, is always zero. An equivalent way of saying this is that the work done by the conservative electric force between any two fixed points depends only on the positions of the two points, and not on the path we take in

getting from one point to the other. Mathematically we write this as:

$$\oint \underset{\sim}{E}_{CON}.\underset{\sim}{dl} = 0$$

With a conservative force field we can generate a function of position which is real valued. This scalar valued function is called a potential energy function, and applies only to conservative force fields. With this potential energy function we can talk about the potential energy or potential difference between two points; this is the same concept that relates to PD in circuit theory.

With a non-conservative force field you cannot find a potential function, because the work done by the non-conservative electric force over some closed paths may not be zero. The work done by the non-conservative force depends on the path taken, between two given points. In fact the work done by the non-conservative electric force, through a closed path or loop — which is not equal to zero — is ***defined*** *as the EMF of the loop. Mathematically this is written as:*

$$\oint \underset{\sim}{E}_{NC}.\underset{\sim}{dl} = EMF$$

In a nutshell, potential difference applies to a conservative electric field, while EMF applies to a non-conservative electric field.

In lumped circuit theory, which is really an offshoot of field theory, we have three main concepts which relate to electrical energy storage and its dissipation: capacitance, inductance and resistance.

Capacitance relates to energy storage via a conservative electric field, because the fields are produced by electric charges. Inductance relates to energy storage via a magnetic field; ***but*** *(and here is the 'big but') the electric field produced by a changing magnetic field (more accurately, magnetic flux) is a* ***non-conservative*** *electric field.*

(With resistance, the concept relates to irreversible energy dissipation, i.e., conversion of electrical energy to heat.)

So therefore when we talk about the electrical effect of an inductor, we must use the term EMF and not PD. This is a fundamental classic physics effect, and is expressed via Faraday's and Lenz's Law. I.e.,

$$\oint \underset{\sim}{E}_{NC}.dl = EMF = -\frac{d\phi_B}{dt}$$

where E_{NC} *is the non-conservative electric field and dl is a small differential displacement.*

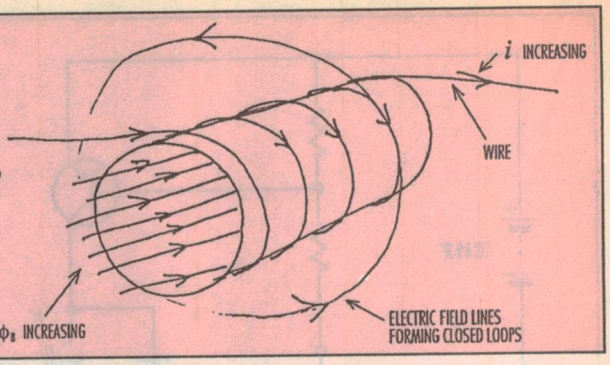


Fig.5: A diagram supplied by Mr Mainwaring to illustrate the formation of an electric field around a charging inductor.

and

$$\underset{\sim}{E}_{NC}.\underset{\sim}{dl} = \Delta EMF = |\underset{\sim}{E}_{NC}|.|\underset{\sim}{dl}|.\cos\theta$$

where θ *is the angle between dl and the field vector.*

What this equation says is that the work done by the non-conservative electric field around a closed loop is equal to the negative of the time rate of change of the magnetic flux through the loop. This work is known as the EMF of the loop.

The negative sign is very important, because it gives us the direction of the EMF, in that the EMF is in such a direction that it does not violate the Conservation of Energy Law in physics. This negative sign is essentially Lenz's law.

In other words, someone has coined the term 'back EMF' to remind us of Lenz's and Faraday's law, which is a fundamental law of classical electromagnetism.

When an inductor is charging, the magnetic flux through the core of the inductor is increasing, therefore by Faraday's law a non-conservative electric field is generated. These electric field lines form closed loops around the inductor. Therefore we must have an EMF being generated by the inductor, because the electric field produced is non-conservative.

Notice that the electric field lines (Fig.5) are in the opposite direction to the current; i.e., they ***oppose*** *the current that has indirectly produced them. This is in essence the 'back EMF'.*

In fact if we imagine a path which follows the helical winding of the inductor, each loop we go around we get the EMF of one turn; this relates to the turns-per-volt of transformer theory.

A similar argument applies to the situation when the magnetic flux is decreasing. In each case, the term EMF applies, not potential difference.

Mr Comer's arguments about whether one uses the terms EMF or PD, relating to the way an inductor behaves are flawed, because his arguments are not based on fundamental physics, but on a rather vague idea that an EMF is an energy source.

We should use the term EMF with an inductor when the flux is changing through it; this is a consequence of Faraday's law. And there is nothing wrong with the term 'back', because it tells us that the EMF is trying to oppose the current when the flux is increasing, or to aid the current when the flux is decreasing; this is a consequence of Lenz's law.

I certainly will go on using the term 'back EMF', because it is a simple term that shows the physics going on in an inductor. However I think you have done us all a favour, Mr Comer — the basics or fundamentals of any theory is never as basic or as fundamental as many of us are led to believe. I myself always seem to be going back over the fundamentals, and finding that what I thought I understood years ago was in later times found to be not quite complete. Perhaps for all of us it never will be.

Whew! What can I say to all that, Mr Mainwaring — apart from 'Amen'? (And thanks, of course...)

I don't know about the other people involved in this discussion, but I have to admit that I really only followed the broad gist of Alan Mainwaring's argument. I never *could* understand the depths of field theory, and I suspect I'm not alone. In fact by the time I had finished reading this letter, I think I was more confused than ever — it was very much a case of 'I thought I understood about EMFs and inductors, until I read your explanation'.

(By the way, Mr Mainwaring's letter gave me quite a few hassles in preparing it for publication, too. It was written out in longhand, and typing it all in — including those maths expressions — was anything but easy. Please, folks, type your letters if at all possible, or even better send me an ASCII file on floppy disk. And not too much maths with fancy symbols, PLEASE!)

And for the moment, I think we'll leave it at that, as far as back EMF is concerned. Mr Mainwaring has fired the big gun, and there seems little point in the rest of us brandishing our own puny weapons. In any case, we'll have to let our ears recover from the bang! ❖

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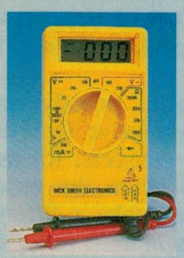
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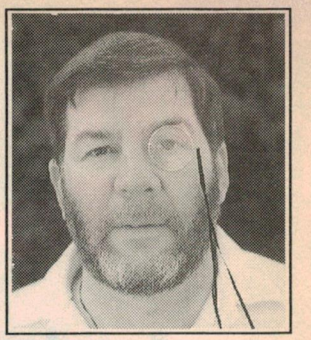
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Moffat's Madhouse...

by TOM MOFFAT



A light in the night, and a mystery solved

Around this time of the year, all eyes look skyward, at least here on the South Island. And clever people with radios keep an ear to the speaker for strange gurgling sounds that herald unusual propagation conditions. Yes folks, it's aurora time!

You hear the terms bandied about: auroral scatter, auroral enhancement. These things are usually considered a nuisance in professional circles, because they disrupt the carefully calculated path losses and circuit times for effective communication. But among radio amateurs, auroras herald some evenings of weird effects and communications into unthought-of places.

If you've ever heard HF radio signals from Antarctica, you'll be familiar with the gurgling sound imposed upon them by auroras. This is especially prevalent in winter. Auroras are like big neon lights in the sky, made up of ionized gasses which glow. And as well as glowing, they reflect radio waves, just like the ionosphere. When auroras are visible they usually look like curtains flapping about in the breeze.

If you imagine an aurora as a curtain made of aluminium foil, and then direct a strong light toward it, the light would scatter and flicker in all directions as the curtain moved. The same thing happens with radio waves directed at an aurora, and the scattering and flickering radio waves give rise to the gurgling sound on signals that have tangled with auroras.

Even though I'm always interested in playing radios, especially when something unusual is going on, I often take gurgling signals as a cue to run outside and look toward the southern sky. And when the gurgling signals are coming from the Big Island to the north of Tasmania, it means that the aurora is directly above us, much further north than usual. And those are the very best.

About four years ago I was at a dinner party, by coincidence sharing a table with Peter Boyer, the publicity officer for the Antarctic Division. I was raving on about how much I enjoyed the Antarctic and particularly the auroras (actually I was campaigning for another trip south, I guess).

Suddenly a voice called everyone out to the veranda behind the restaurant, to look at an aurora that was brewing up to the south. From then on the meal was interrupted every few minutes by trips out the back to watch the aurora, which was growing steadily.

Finally, just before midnight, the party broke up and we all went outside to find that the aurora wasn't just to the south, but all around us. It appeared to form a kind of tent with a point at the top — directly overhead — and multi-coloured rays were shooting up from all points of the compass toward the point. That was some performance, and when we finally got home we dragged the kids out of bed to come watch the show. It went on for several more hours, improving all the time. It meant a wrecked night's sleep for everyone, but it was worth it. And the next night there was a repeat performance, although not quite as good.

It turned out that that particular aurora was seen as far north as New South Wales, and it was also doing its thing over the North Pole as well as the South. It produced a fine auroral show in places like New York City, accompanied by world-wide news coverage.

During my previous voyages to the Antarctic I really got hooked on auroras. No matter where we were, there was always someone keeping a lookout for auroras. On good aurora nights we'd lie out on the deck of the Nella Dan, staring straight up at the curtains of green light that whipped through the sky. Cold, you say? You'd better believe it, but nothing would keep us away. And at places like Macquarie Island, participants of beer-drinking sessions used to excuse themselves from the group to go outdoors and 'check for auroras'. This was really a euphemism meaning 'to relieve oneself' but all the same everyone made sure to look up, as well as down. They were often rewarded.

Here in Tasmania we regularly experience really stunning night-time aerial displays. I sometimes speak with Mainlanders on the phone, saying "You should have seen the aurora we had here last night!"

"Aw, you lucky sod", they say, "we never get them here". What a pity.

Whenever a decent aurora is spotted, one of the local radio stations will issue an 'aurora alert'. This is the signal for listeners, particularly those in cars, to head for a picnic area on Mt Wellington known as The Springs. Here there is a lookout with uninterrupted views to the southern horizon. On a good night the place will be packed with cars, with their occupants standing at the lookout in the freezing mountain cold, watching the show to the south.

Interestingly enough, nobody says much when an aurora is active. Or if they speak, they speak in whispers. It's as if they don't want to scare the aurora away. Animals though, take a different view; an aurora to them must seem like impending disaster. When all the neighborhood dogs start howling, its's worth taking a look outside. If it's not an aurora, then perhaps a werewolf? Certainly worth seeing, anyhow.

Auroras might appear to be things that are pretty, but of no practical value. However they do seem to have their purposes. Consider the following incident, which had the potential of turning into a really nasty situation:

One night during my time as a journalist at a Hobart TV station, we got a tip-off about something that had the potential of being a Big Story. A young fellow named Bucky was holed up in a house along a road in the Mt Wellington foothills, threatening everyone with a gun. The place was surrounded by police, with the biggest contingent stationed on the road itself, keeping a watch on the house in the valley below. A Tas-TV news crew just had to be there.

A cameraman and I made a silent approach in the news van, lights off, sneaking up on the scene. When we saw the cop cars in the distance we got out and started walking, assessing the situa-

tion as we went. Police, dark shadows in their blue bushwalking coats, were milling everywhere. And from down in the valley below the road we could hear this voice: "COME OUT WITH YOUR HANDS UP, BUCKY! WE'VE GOT YA SURROUNDED!"

Golly! This was just like the movies! A genuine siege situation in quiet little old Hobart. As we moved closer, we could almost feel the air crackle with tension. This was Heavy Stuff.

By some stroke of good luck someone at Tas-TV had arranged for news crews to be equipped with blue bushwalking jackets exactly like those supplied to the police. So the police thought we were more reinforcements coming, until we got close enough for them to see the camera. Down in the valley the drama continued: "THROW OUT THE GUN, BUCKY! WE'VE GOT YA COVERED". And then on the road: "Hey! What are you guys doing here?"

Ah, well, nabbed in the act. We were hustled back down the road, to a 'safe distance'. We stood there waiting, and smoking, and listening — "COME ON OUT BUCKY! YA GOT TEN MORE MINUTES".

This went on for at least an hour. Then a cop, one of the leaders, came toward us. Well, that's it, we thought. They're going to storm the place — but they're going to throw us out first!

But that wasn't the cop's mission at all. "I see you guys have got some cigarettes." Yes.

"Can I borrow some for the men back there? We've run right out". Think, quick!

"Only if we can deliver the smokes ourselves, back up the road where you are." Relations between the press and police in Tasmania have generally been pretty good, so negotiation is usually possible. The cop thought about it for a while and then gave in. After all, one good turn deserves another — and we were soon back in the centre of the action.

More waiting. The tension grew; everyone's nerves were twanging like guitar strings. And then came a young constable's voice:

"Hey, look up there!". And another. "Hey, yeah, far out!"

Bucky was forgotten for a moment as all eyes turned to the southern sky to view a lovely, multi-coloured, pulsating aurora. It was a ripper, one of the best in years.

"ALL RIGHT, BUCKY, LAST CHANCE. COME OUT WITH YOUR HANDS UP!" The cop down in the valley was taking cover in the trees, and he probably couldn't see the aurora. His voice jerked everyone back to reality, but by then the atmosphere was noticeably relaxed. The police went back to watching the valley, and the aurora, at the same time.

"Oh wow! It's turning purple!"

Eventually the cameraman and I gave up and went home. The Big Story just didn't have that power and tension any more. Several hours later Bucky gave up as well. Quite peacefully, no drama. I don't know what finally convinced him. Maybe the cops changed their tune:

"HEY BUCKY, COME OUT AND HAVE A LOOK AT THIS GREAT AURORA!" Yeah, that had to be it. Who said auroras are useless?

Mystery solved

Now let's change the subject slightly. You may remember some months ago in this column I presented a satellite picture received aboard an Antarctic research ship by personnel from the Australian Bureau of Meteorology. The satellite receiver's computer determined that the picture was from the polar orbiting satellite NOAA 9, which it figured was going over the North Pole instead of the South Pole at the time.

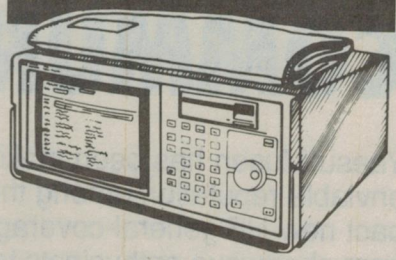
This picture thus became a major mystery, suggesting all kinds of weird and unusual skip conditions allowing VHF transmission half way around the world. The picture appeared to show the northern parts of Canada and Alaska in relation to the North Pole, so it seemed legitimate enough.

I personally thought auroras might be involved somewhere, but I still had doubts about the picture, particularly because its coverage seemed to be of a much wider area than is normal for NOAA 9. I had received many pictures from NOAA 9 via the Listening Post WESAT decoder, and I had never seen NOAA 9 display more than a small slice of the Antarctic Coast. The 'mystery picture' appeared to show at least half of the Arctic polar ice cap.

Now I hate to screw up a good story with the facts, but here goes. The Hobart Weather Bureau did LOTS of digging into the circumstances surrounding the mystery picture, and they managed to prove once and for all that the picture was indeed from the Antarctic, not the Arctic.

It seems the little on-board computer within their satellite receiver had suffered from a bout of temporary insanity. Fair enough, the picture itself did look like Canada and Alaska and the North polar regions, but they were just good old clouds with suggestive shapes. If you look at anything long enough you can read anything you want into it. Have you ever seen the man in the moon? ❖

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As featured on our front cover:

YAESU'S NEW FRG-100 COMMUNICATIONS RECEIVER

Yaesu Musen has been making radio equipment in Japan for just on 37 years, and has earned an enviable reputation among the world's radio amateurs. But the latest addition to its range is a compact new HF general-coverage communications receiver, designed for a wider market — stretching from shortwave enthusiasts to professional spectrum monitors.

by JIM ROWE

Although perhaps better known for its amateur radio transceivers, Yaesu has of course also made a smaller range of communications receivers, for quite a while now. Its FRG-8800 general coverage HF/VHF communications receiver has a very good reputation, while the FRG-9600 VHF/UHF scanning receiver is widely used by those who explore or work in the spectrum from 60 - 905MHz.

Now the company has added a new model to this range: the FRG-100, a 'little brother' for the FRG-8800. But don't be mistaken — although the new set may be only about 70% the size and half the weight of its older brother, it's by no means lacking in terms of performance and facilities. In fact it actually exceeds the performance of the earlier design, in a number of areas.

The new set measures only 238 x 93 x 243mm, and weighs a very modest 3kg (although this is no doubt helped by the fact that it has no inbuilt mains power supply). It comes in a light but sturdy metal case, with a high quality black finish and a matching moulded plastic front panel. Both the main LCD display panel and separate S-meter are nicely backlit, and the main frequency readout provides crisp digits 8mm high for excellent readability.

The FRG-100 provides general coverage of the HF spectrum from 130kHz to 30MHz, with CW, AM, AM narrow and LSB/USB modes fitted as standard. An FM receiving module is available as an option, and further options include two alternative narrow-band IF filters for higher selectivity in CW mode, and a TCXO (temperature compensated crystal oscillator) for higher stability.

Tuning is performed via a large rotary knob (40mm in diameter), and/or a pair of 'Up' and 'Down' increment buttons. The tuning knob is in fact attached to a rotary optical encoder, and merely provides an alternative way to produce incrementing of the tuning in either direction. A 'Fast' button toggles between two different tuning increment sizes. For AM and the optional FM mode the tuning increments are either 100Hz or 1kHz, while for CW and SSB they are 10Hz and 100Hz — all well chosen for convenient tuning in the various reception modes. (In any case it's also possible to program your own Fast tuning increment for each mode, with a range from 100Hz to 100kHz...)

Like most modern communications receivers the FRG-100 is microprocessor controlled. In fact there are two processors inside, the main one controlling primary receiver operation and a 'slave' unit which looks after the front panel display and control functions. The main processor uses a DDS/PLL (direct digital synthesiser and phase-locked loop) system for tuning the receiver, which is of the double-conversion superhet type. The first mixer upconverts the incoming signals to a first IF of 47.21MHz, while the second mixer converts back down to a standard second IF of 455kHz. The high first IF gives the receiver very good image rejection (rated at better than 60dB between 1.8MHz and 30MHz) and IF rejection (better than 70dB), while the low second IF provides the good selectivity.

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MW	0.520 ~ 1.625
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75	3.900 ~ 4.000
60	4.750 ~ 5.200
49	5.850 ~ 6.200
41	7.100 ~ 7.750
31	9.350 ~ 9.900
25	11.550 ~ 12.050
21	13.600 ~ 13.900
19	15.100 ~ 15.700
16	17.550 ~ 17.900
—	18.900 ~ 19.300
13	21.450 ~ 21.850
11	25.670 ~ 26.100

Fig.1: The FRG-100 has 16 inbuilt 'bands', corresponding to those used for international broadcasting.

The selectivity of the FRG-100 in each mode is actually very practical. In AM mode the quoted bandwidth is 6kHz between -6dB points and 18kHz at the -50dB points, while in AM Narrow mode these figures reduce to 4kHz and 15kHz respectively. The standard IF filter used for both SSB and CW modes gives corresponding figures of 2.4kHz (-6dB) and 4.5kHz (-60dB), which is close to ideal for SSB reception but less so for CW. However the optional CW narrow filters provide a choice of either 500Hz or 250Hz bandwidth, for those who really need to pluck Morse signals out of crowded and noisy bands.

The optional FM module provides a bandwidth of 15kHz at the -6dB points and 30kHz at -60dB, making it quite suitable for resolving the FM found on the upper HF bands.

By the way, a very nice feature of the FRG-100 is that although the IF 'carrier offsets' in SSB mode and the 'BFO beat note' in CW mode are factory preset to 'good compromise' settings, they can all be re-programmed by the user if they wish. The LSB and USB offsets can each be independently adjusted between 452 and 458kHz (i.e., +/-3kHz), while the BFO note can be set for either 400, 500, 600 or 700Hz as desired. The factory defaults are for +/-1.5kHz and 600Hz respectively.



The CW mode can also be programmed to place the BFO effectively on the 'high' side of the carrier (as in LSB reception) instead of on the default 'low' side, for those who wish to be able to switch rapidly between CW and LSB modes without retuning. This would make the receiver excellent for monitoring amateur transmissions on the 160m, 80m and 40m bands, where LSB is used.

In addition, and independently, the BFO in CW mode can be set for either the default offset on the 'low' side of the IF bandpass curve, or on the 'high' side instead. This can be used to maximise adjacent signal rejection.

The sensitivity of the receiver is also very impressive, with quoted figures in SSB/CW mode of better than 0.25uV between 1.8MHz and 30MHz, with a small dip in the MF area and drooping a little at lower frequencies, but still better than 4uV at 130kHz. The corresponding figures for AM are 1uV and 10uV, and all of these are for 10dB signal to noise ratio — making the FRG-100 significantly more sensitive than its older brother. The sensitivity in FM mode with the option fitted is quoted at better than 0.5uV for 12dB SINAD, between 28MHz and 30MHz. The tuning stability of the receiver is rated at better than 10ppm between -10° and +50°C with the standard crystal master oscillator fitted, while the optional TCXO improves this by a factor of about 5 times, to better than 2ppm between 0° and +50°C.

Broadcast band modes

Although the FRG-100 doesn't have the frequency entry keypad provided on some modern communications receivers, to allow rapid changing to a desired band, it gets around this apparent limitation in a novel and convenient way.

The processor has stored in it some 16 different frequencies, each of which corresponds to the lower band edge of one of the international broadcasting bands (Fig.1). By holding down the 'Set' button and briefly pressing the Up tuning increment button, the receiver flips into its 'Broadcast Band Selection Mode'.

If you then select the Fast tuning mode, the Up and Down tuning buttons effectively become bandswitching keys, taking you quickly up or down the HF spectrum and at the lower edge of the various commonly used bands. Once to the spot nearest your desired frequency, you can flip back to Normal tuning mode and use either the rotary knob or the Up/Down buttons for normal tuning in either direction. Very nifty!

Quite apart from this, the FRG-100 also provides 50 memory channels for storing frequency and receiving mode information for often used signals. Selection of any desired memory channel is also made via a separate rotary control (another optical encoder), so that the memory channel can be selected very easily without disturbing the current tuning.

Needless to say the receiver also provides the usual Memory Clear, VFO to Memory Write, Memory to VFO Copy and VFO/Memory alternate buttons, giving plenty of flexibility in terms of memory writing and using the stored information. There's also a Lock key for the tuning, to prevent accidental disturbance to reception.

Other receiving features include independently switchable RF input attenuators of 12dB and 6dB, a switchable noise blanker and selection of either a Fast or Normal AGC recovery characteristic, for optimisation in the various receiving modes.

Scanning modes

Not surprisingly, like many other modern receivers with processor-controlled synthesiser tuning, the FRG-100 provides a range of frequency scanning modes. There are a total of four modes available: Memory scanning, Band scanning, Priority and Group scanning. These are all used in conjunction with the set's adjustable Squelch control, to check automatically for channel activity.

As the name suggests, Memory scanning allows checking for activity on either all, or selected memory channels; Band scanning allows scanning between any two frequencies, 'Lo' and 'Hi', which can be stored in two additional memories provided for this purpose; Priority scan allows monitoring of any desired single memory channel, while using the receiver normally with manual tuning; and finally Group scanning allows memory scanning by an assigned group or pattern (instead of the sequential order used in Memory scanning).

Actually it's also possible to arrange scanning of any of the 16 inbuilt AM international Broadcast Bands mentioned earlier. This is done simply by setting the receiver into this mode as described, selecting the desired band, and then pressing the Scan button after closing the Squelch control. The scanning limits are automatically set to the top and bottom of the band concerned.

In short, then, the FRG-100 provides plenty of flexibility in terms of scanning, and the programming for each mode is quite straightforward and logical.

Incidentally the receiver is fitted as standard with Yaesu's CAT (computer aided transceiver) interface, which allows it to be connected to and controlled by a personal computer. The receiver's frequency, reception mode, memory operations and quite a few other functions can be controlled by the PC, using simple programming in BASIC or almost any other convenient language.

Among the other facilities provided by the FRG-100 are *two* inbuilt digital clocks, to allow one to be set to local time and the other to UTC or whatever. The clocks can be set for either 24-hour or 12-hour readout, as desired. The clock circuitry can also be programmed to 'chime' on the hour by emitting a pattern of 'beeps' (two short, one long), so you don't lose track of the time when engrossed in listening. (The clocks share the same readout, so the time isn't visible when frequency is displayed.)

Associated with the clocks are three timers, two which allow programming for the receiver to be turned On and Off at specific times, and the third a 'Sleep' timer to allow automatic turnoff after a programmed period (up to two hours).

Another nice little feature of the FRG-100 is a 'diagnostic test' function, which

lets you check the operation of the set's LCD readout panel and microprocessor, as well as showing the ROM firmware version fitted. By holding down the Set button when you turn the set on, the micro is forced to cycle through a test sequence (which doesn't disturb any memory data), and produce a 'Las Vegas Display' on the LCD (so that all legends are turned on together). Finally the word 'YAESU' is displayed, along with the firmware version number, before the set returns automatically to normal operation.

As mentioned earlier, the set has no inbuilt mains power supply, but is designed to operate from a nominal 12V DC supply — either a battery or a separate mains supply. This makes it equally suitable for portable, mobile or fixed operation.

A matching AC adaptor is available from Yaesu, but any standard supply delivering 11 - 14V DC at 1.2A maximum is suitable when the receiver is to be used near a mains outlet.

On the rear panel of the FRG-100 are a small coaxial connector for the DC power input, 3.5mm jacks for connection of an external speaker and tape recorder if desired (the set has a small internal speaker), a 2.5mm jack for remote on-off control of a tape recorder from the receiver's Squelch circuitry (for automated monitoring), an RCA socket for remote muting of the receiver during transmit (when it is used with a transmitter), a 6-pin DIN socket for the CAT interface, a bolt with wingnut for safety earthing, and the antenna connectors.

The set can operate directly from either a 50-ohm low impedance or a high impedance (nominally 450 ohms) antenna, as desired — both unbalanced with respect to earth. An SO-259 socket is provided for the 50-ohm input and a pair of spring terminals for the 450-ohm input, with a mini-slider switch used to select between the two. Another mini-slider allows the internal memory backup cell (of the Lithium 'button' type) to be disconnected, if desired.

As you'd expect from Yaesu, the FRG-100 comes with a comprehensive and very readable operating manual. There's also a complete set of schematics, plus a block diagram and a PCB interconnection diagram. Hardware accessories supplied include a DC power cable, two fuses, an RCA plug and both 3.5mm and 2.5mm jack plugs.

What we found

Dick Smith Electronics, the Australian distributor for Yaesu, very kindly loaned us a sample of the new FRG-100 so that we could try it out for ourselves. Checked out with the instruments, we found its sensitivity to be generally well within the quoted figures — and thus very impressive.

A small droop in sensitivity was noted in the region of the medium-wave band, as shown in the specification (and possibly deliberate, to minimise overload and cross-modulation). The only other thing we noted was another small droop at the top end, this time bringing it just out of spec on the CW, SSB and AM modes — but not by enough to worry about.

The measured selectivity figures also matched those specified quite closely, with the CW/SSB filter having very steep rolloff beyond 2.4kHz. And although we currently don't have the equipment to measure tuning stability to this order of accuracy, the correlation between its own tuning and that of our signal generator with its oven-stabilised reference and synthesiser, suggested that it was well within the specification.

As one might expect from the use of such a high first IF, the image rejection was excellent — rather hard to measure, in fact, because it *is* so good. The same applies to the IF rejection, so in these respects the performance of the FRG-100 is excellent.

The measured current drain of the sample unit was only a little over 800mA maximum at 13.5V DC, so that operation from a nominal '1A' power supply should be quite acceptable.

As well as making the instrument measurements, we were also able to use the FRG-100 for 'live' reception, with a reasonably elevated and balanced HF dipole antenna (fitted with a balun for matching to an unbalanced receiver input). The results were most impressive, and showed that this receiver is both an excellent performer and very easy to use. The tuning is very smooth, the memory system both flexible and convenient, and the other controls also very 'friendly'.

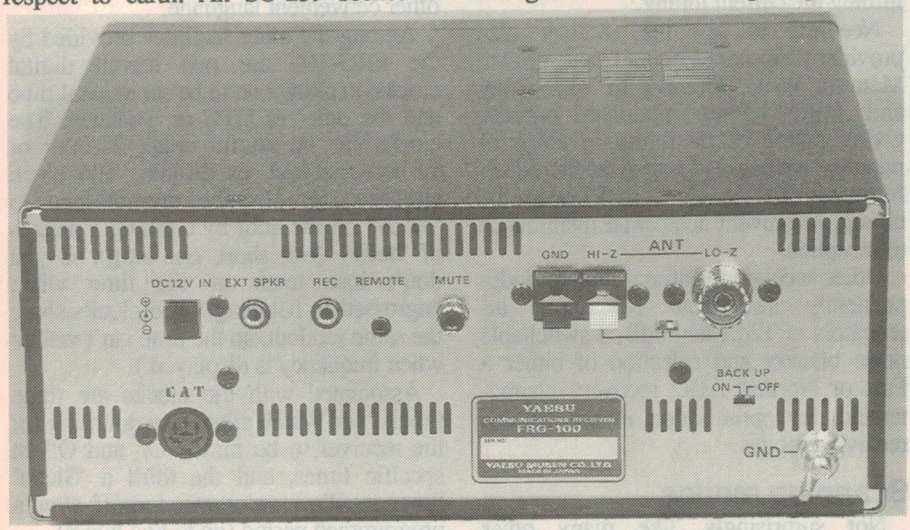
Although we had anticipated that the lack of a frequency entry keypad might make large tuning jumps a little inconvenient, this turned out to be a relatively minor problem — thanks to the FRG-100's 'Fast' button and optional 'Broadcast band' switching mode. Once you get the hang of these, even quite major jumps in tuning frequency are achieved with relatively small effort.

As with most modern microprocessor-controlled and synthesiser- tuned receivers, there were a few 'birdies' or spurious signals evident when tuning over the spectrum. In particular we found one at 10.485MHz (the frequency of the set's internal reference crystal), and others at 455kHz, 12.288MHz and 22.700MHz. As usual they are fixed and unmodulated 'pseudo-carriers', and unlikely to cause problems in normal operation.

In summary, then, we found the FRG-100 an excellent performer, and a very worthy addition to the Yaesu range of communications receivers. It would make an excellent choice for either the hobby shortwave enthusiast or professional HF band monitor.

The quoted retail price for the new FRG-100 is $999.00, and it carries the DSE catalog number D-2790. You should find it in stock at all Dick Smith Electronics sales outlets.

Our thanks to Chris Ayres of DSE, for the loan of a sample FRG-100 and his assistance in the preparation of this review. ❖

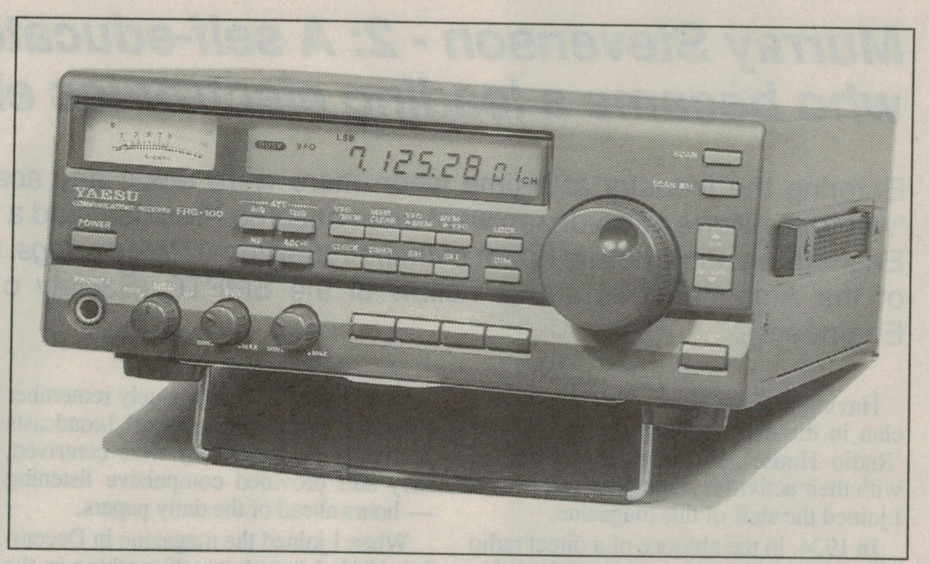


All of the input and output connectors except the phone jack are found on the rear panel. Both low and high impedance antenna inputs are provided.

Here's your chance to win one of these superb new Yaesu FRG-100 communications receivers!

Dick Smith Electronics, the Australian distributor of Yaesu Musen products, has provided *Electronics Australia* with one of their exciting new FRG-100 Communications Receivers, to be offered as a prize to our readers. So here's your chance to acquire one of these state of the art receivers — worth $999 —simply by putting your imagination to work!

Both DSE and ourselves wanted to make this a competition where our younger readers would have just as much opportunity to win the prize as those with more experience or knowledge of electronics. But we didn't want it to be a mere lottery or 'game of chance', either... So we put our heads together, and here's what we came up with:



The Dick Smith Electronics/EA

'If only they'd had a Yaesu...'

Competition

That's right, what we're asking you to do is imagine a famous moment in history, when things might have been very different — if only the people concerned had been able to make use of modern radio communications equipment like that made by Yaesu Musen. What if Dr Livingstone had been able to radio for help, for example, when he became lost in the African jungle? Or General Custer had been able to call for reinforcements, when his troops were being outnumbered by the American Indians? Or Julius Caesar's wife had been able to call an ambulance, when her husband had been stabbed? These are just a few examples, to get your imagination going. You'll be able to come up with a much better example than these, we're sure...

All you have to do is come up with an imaginative and entertaining short story, which tells in only 250 words or less how history might have changed if only they'd had a modern Yaesu radio transceiver or receiver (and someone else with one at the other end, of course!). The reader who comes up with the entry we judge the most imaginative and entertaining, will win the Yaesu FRG-100. What could be easier? (By the way, we'll be publishing both the winning entry and the nine runners-up in the magazine, and these entries will each attract a fee of $40.)

But don't delay! You only have until the end of July — your entry must be posted no later than July 30, 1993. Note that no employees of Dick Smith Electronics or Federal Publishing Company, nor their families, are eligible to enter this competition; also that our judges' decision will be final, and no correspondence can be entered into following the judging...

Post all entries to: 'If Only They'd had a Yaesu' Competition, c/- Electronics Australia, PO Box 199, Alexandria 2015. There is no fee for entering this competition, but you must pay the postage!



When I Think Back...

by Neville Williams

Murray Stevenson - 2: A self-educated student who became a leading electronics engineer

Entering the industry at a time when there were few if any academic training courses in basic 'wireless', Murray Stevenson went on to become President and a 'Fellow' of the Institution of Radio Engineers and Honorary Editor of their professional *Proceedings*. He was also a respected member of the American IRE and a Fellow of the SMPTE (Society of Motion Picture and Television Engineers).

Having become aware of the Stevenson clan in the early 1930's, per medium of 'Radio House', I was again confronted with their activities some years later when I joined the staff of this magazine.

In 1934, in the absence of a direct radio link, 2UE had set up — in competition with the ABC — to simulate live test cricket broadcasts from England. This was in co-operation with Associated Newspapers Ltd, with whom they had developed close business ties.

For the purpose, Murray Stevenson installed and equipped a small studio on the thirteenth floor of the then imposing *Sun* building, near the corner of Elizabeth St and Martin Place. Built from caneite over a timber frame, the studio was furnished with comfortably padded chairs around a large wooden table, plus a couple of transverse current mics, two low voltage DC-powered 78rpm turntables with slipping clutch drives and two Marconiphone studio type phono pickups. On match days, overseas despatches describing the progress of play were received in rapid succession through the newspaper's cable facilities and delivered directly to the studio by a team of copy boys.

In the studio, a couple of sports announcers, one of whom Murray remembers only as 'Captain', translated this basic information into an impromptu running commentary, interspersed with relevant small talk. As they did so, a pencil tapped on the table doubled for the sound of ball on bat, while turntable operators maintained a suitably atmospheric background of recorded crowd noise.

Looking back, I can vaguely remember listening to these 'phantom' broadcasts but while we knew they were contrived, they still provided compulsive listening — hours ahead of the daily papers.

When I joined the magazine in December 1941, I found myself working in the same building one floor below the old studio — now unused and deserted — but with the turntables, pickups and one microphone still in place. It fell to my lot to dismantle them, some years later, when the studio was re-fitted to serve as the nerve centre of the *Sun*'s mobile radio news-gathering venture.

I stored them at home until they posed a space problem, at which point they were passed over to the Sound & Film Archive in Canberra, where they presumably still are.

Incidentally, I was reminded by the *B&T* magazine liftout mentioned last month, that 2UE did another widely publicised phantom broadcast in 1946 — the Vic Patrick/Tommy Burns welterweight championship fight in the old Sydney Stadium.

A rigger's rigours

In the late 1930's, with radio stations competing vigorously for audience share, 2UE management decided that the station needed a more powerful signal. However attractive Lilli Pilli might once have been for a small family station, the terrain was unsuitable and, being on the south-eastern fringe of the city, a large sector of the coverage was being wasted anyway, on adjacent bushland and the rolling blue Pacific.

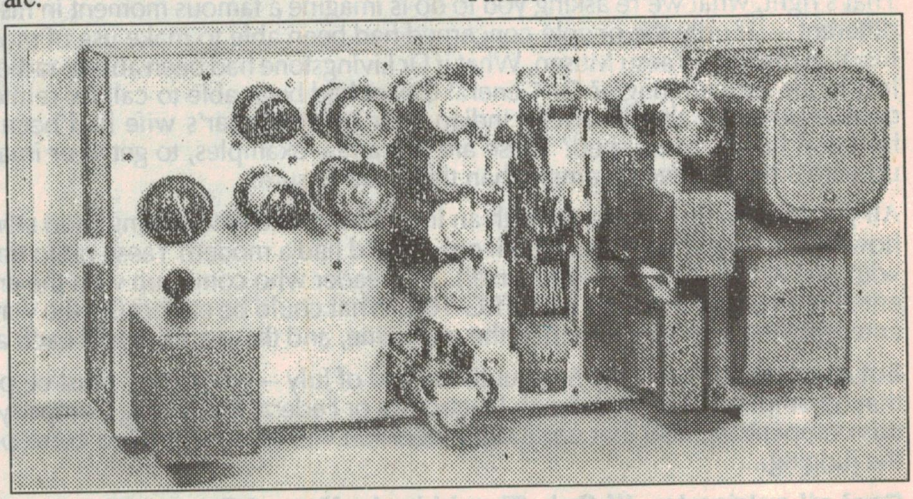


Fig.1: The automatic monitor for standard time signals installed in the late 1930's by 2UE technical staff under the supervision of Murray Stevenson.

The logical course was to invest in a new transmitter and set it up with a vertical 'quarter-wave' mast, on the moist river flats near Concord — then roughly the geographical centre of the Sydney area. Vertical masts were reputed to concentrate more of the radiation field in a 360° ground wave, thereby improving regional coverage.

With the mast resting on insulators, the signal could logically be 'series fed' between the bottom of the antenna and ground. From overseas literature, however, Murray had reason to believe that that 'shunt feed' was quite practicable, with the signal drive tapped part way up a mast that was earthed at the bottom. It sounded like a better idea, if only as a protective measure in the event of a lightning strike.

Playing it safe, Murray said that he specified a slender, self- supported tapered tower, something over 200ft tall, with four legs forming a 10ft (3m) square, each resting on a large insulator. By bridging each one with an earth strap, he could have a fully earthed, shunt-fed tower. If it didn't come up to expectations, he could simply remove the straps and revert to conventional series feed!

As he said: "To short out four insulators would be easy. To install insulators after the tower had been erected would have been a very different matter"!

In July 1939, Murray and his technical off-siders had to set up and adjust the transmitter/tower feed — a job which could only be done late at night after the existing 2UE transmitter had been turned off, thereby clearing the channel.

So it was that, on a bitterly cold winter's evening, they assembled the appropriate lights, tools and instruments at the foot of the new mast, plus a fire in a 40-gallon drum with enough wood and coke to provide at least an illusion of warmth.

Around midnight, when 2UE closed down, someone had to climb the ladder to select the cable feedpoint for an optimum impedance match, while the others tended the instruments.

In the absence of volunteers, Murray had to climb the ladder himself, only to realise that a South Australian station was still on air and pumping enough energy into the new mast to upset the instrument readings. "So", said Murray, "The Chief Engineer had to fiddle and freeze 80ft (25m) above the ground, while the other so-and-sos crouched around the fire!"

The new mast worked fine, he said. But a few weeks later, army sappers appeared on the site with instructions to attach explosive charges to the legs of the mast. If Australia was invaded, they certainly didn't want the enemy to be provided with viable broadcasting stations.

"Fortunately, the military didn't need to press the button and the mast remained intact until it was subsequently replaced by a much taller one of uniform cross-section, on a site large enough to permit the use of guy wires."

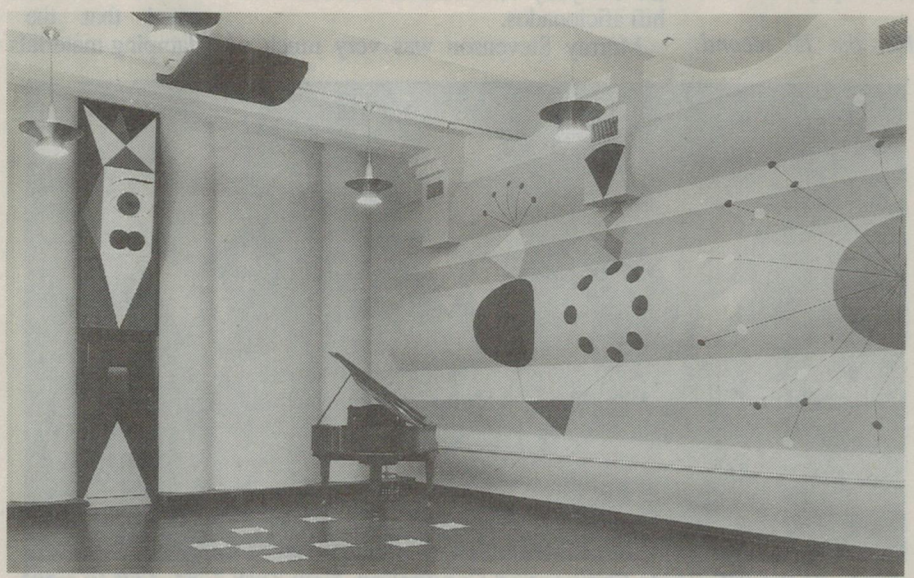


Fig.2: An original photo of 2UE's acoustically 'live' studio, designed by Murray Stevenson. Hard, non-plane, non-parallel surfaces reflected sound without setting up sustained spatial oscillation modes.

Having a good time

As radio stations grew larger, busier and more involved in programme production and distribution, accurate time — and timing — became progressively more critical.

In the era before 'quartz' technology took over, 2UE relied on mains-synchronised clocks, checked each hour on the hour against standard format time signals available on-line from the Sydney Observatory.

In 1937, with the consent of the Observatory, 2UE decided to broadcast the time signals, foreshortened — for convenience — to warning pulses at 30, 20 and 10 seconds to each hour. At five seconds to, a sequence of six brief pulses one second apart registered 5, 4, 3, 2, 1 and 0 — the last indicating the exact 'o'clock'.

An article in the October 1939 issue of this magazine (then *Radio & Hobbies*) told how Murray and his off-siders had devised an automatic monitor that would sense all pulses on the Observatory line — spurious or otherwise — but respond only to one that was followed by two other pulses at 10-second intervals.

Thus activated and anticipating a succession of six timing pulses, the monitor would automatically superimpose equivalent tone 'pips' from an in-built audio oscillator directly on the signal line to the transmitter, thereby giving station personnel and listeners alike hourly access to standard time signals.

Supplementary circuitry would also flash indicator lights to warn announcers and panel operators that a time signal was coming up, as well as displaying a fault signal for the duty technician if it sensed an apparent malfunction.

In modern technology such a device would probably involve a few transistors and/or ICs on a printed circuit board. In 1939 it called for something equivalent in size and weight to an old-time hifi amplifier, but styled to mount in a 19-inch (480mm) equipment rack. As pictured in Fig.1, space on the chassis was taken up by valves, transformers, filter components, PMG relays and a stepping switch! What follows is a precis of the original explanatory text:

Two of the relays are associated with time delay circuits using gas discharge tubes to provide delays of nine and 11 seconds respectively.

The first pulse, 30 seconds before the hour, operates the line switch which steps from position 1 to position 3, activating a power supply and setting in operation the nine and 11-second time delay circuits. Since the next pulse comes 10 seconds later, i.e. 20 seconds to the hour, it is obvious that it will fall between the operation of the two time-delayed relays.

The circuit is so arranged that, unless the succeeding pulses occur within the limits set by these relays, no further rotation of the line switch will take place.

If a second pulse arrives at the right time, however, it will restart the time delay circuits from zero, preparing for the next pulse at 10 seconds to the hour.

This, too, will operate the line switch, causing another relay to be brought into circuit which responds directly to the Observatory pulses, thereby applying the six resulting pips to the studio equipment as a time signal.

After the last pulse, the 11 second relay is allowed to function, resetting the rotary switch to standby and interrupting the power supply.

Though bulky and clumsy by modern standards, according to Murray, the system worked fine until wartime overload of the power stations made it impossible for the supply authorities to avoid frequency and voltage variations.

As a result, synchronous clocks often slowed during the day and picked up again at night, being out of step with the time signals for much of the time.

2UE got around the resulting confusion only when Murray discovered that AWA could supply a low power crystal-locked AC power supply, sufficient to run the station's synchronous clocks. It, too, was large and expensive but it did the job.

A rival Sydney station sought to get out of the same kind of trouble by relying on master/slave clocks and using them to trigger their own simulated time signal. The authorities were not impressed, however, pointing out that standard time signals provided a reference for navigation purposes and the broadcasting of makeshift signals could lead to confusion and hazardous errors.

Murray the hifi buff

If the foregoing seems to imply that Murray Stevenson was concerned purely with medium-wave, medium-fi broadcasting, such was certainly not the case.

Throughout the 1930's, a bevy of mainly British audio buffs had been 'stirring the hifi pot' with sometimes controversial articles, brochures, books and products. One of their number, Gilbert Briggs of Wharfedale, listed more than 60 of them in his book *Audio Biographies* (1961) including W.A. Chislett, N.H. Crowhurst, 'Free Grid', A.C. Haddy, S. Kelly, P.W. Klipsch, G.W. Tillett, P.J. Walker and P. Wilson.

If one may mix a couple of metaphors, their assorted creeds spread like a scrubfire to the Australian scene, such that audio topics featured large in the technical press and dominated much of the everyday conversation between local hifi aficionados.

Murray Stevenson was very much a part of this scene, except that he was more conscious than most that the considerations in broadcast and recording studios differed greatly from those in private lounge rooms.



Fig.3: At the IRE (USA) Engineering Convention, New York 1951. Left to right are Sir Robert Watson Watt (UK), Sir Ernest Fisk (Aust) and Murray Stevenson, Past President of the IRE (Aust).

Far from being accepted, many of the ideas, techniques and products being passionately debated by hifi 'cultists' were, in fact, seriously questioned by many audio/studio professionals.

In practical terms, working under pressure, announcers and panel operators could simply not be expected to fuss around with gimmicky gadgets or frail super-dooper phono decks. While conceding the importance of sound quality, everyday reliability was considered more important than the obscure, ultra-subtle 'musicalities' often targetted by the 'golden-ear' brigade.

Over the years, 2UE had itself installed most impressive recording facilities for in-house and network production, including both top quality tape machines and microgroove disc mastering using then-new heated styli. Over and above this direct involvement with 2UE, Murray was also a consultant to the Australian Record Company, from 1936 to 1944 and a director from 1940 to 1944.

Radically new studio

Perhaps Murray Stevenson's most notable personal contribution to this general field was a sound studio designed and installed by 2UE in 1952.

To that point in time, most studios had been routinely lined with celotex, caneite, heavy drapes and thick carpet — all intended to prevent the original sound from being obscured by studio echoes.

Tests and observations, however, indicated that the absorption of such damping materials was selective, increasing with rising frequency. As a result, musical performances lost much of their top-end 'sparkle' — an effect that became ever more frustrating with pro- gressive improvements in sound reproducing systems.

In a complete break from tradition, Murray came up with a studio which was largely devoid of absorbent surfaces (Fig.2). Instead, the walls and ceiling were of firmly braced masonite broken up by triangular and partially spherical ridges. As well, the studio was of non- rectangular shape and of deliberately diverse dimensions.

The idea was that sound would be reflected rather than absorbed, but so dispersed by the irregular surfaces, that it would not set up sustained spatial oscillation modes. High frequency 'sparkle' would thereby be preserved and low frequency energy modes dissipated, more effectively than by practical absorbent treatment.

Murray says that his expectations were justified by observations and tests, with sound balance markedly more natural. In fact, some years later, when installing a large video recording studio for Sydney's TV Channel 7, exactly the same principles were applied to good effect.

Sound film technology

As it happened, Murray was also well informed on the subject of sound

picture technology — perhaps by good fortune.

The early link between 2UE and Associated Newspapers Ltd brought him into contact with the managerial Denison family, and an entrepreneur by the name of Fred Daniels.

They, in turn, had been toying with the idea of producing Australian feature films, taking advantage of the old Pagewood film studios.

There would be no problem in obtaining the necessary sound cameras and other associated equipment, but they were unsure about obscure production techniques which might conceivably spell the difference between success and failure.

The answer? Send Chief Engineer Murray Stevenson to America to see how it was done, and take note of 'tricks of the trade' that might otherwise have had to be discovered the hard way. So it was that, during 1938, Murray found himself to-and-froing across the Pacific in the *Mariposa* and the *Monterey* at Company expense, with his mind focussed on sound motion pictures.

In the process, he did the rounds of the Hollywood studios and was invited to 'sit in' on the production of a typical film, where he was able to monitor the whole procedure.

From there, he visited Chicago, Western Electric, RCA and the SMPTE (Society of Motion Picture & Television Engineers). The SMPTE made him especially welcome and arranged membership on the spot.

Nothing came of the Pagewood proposition, but Murray maintained his connection with the SMPTE and regularly digested the contents of their journal. In due course, he was made a Fellow of the Society and was a founding member of their Australian branch.

Looking back on those days, I well remember that, if anyone needed to clear up a point about film technology, one obvious recourse was to "give Murray a ring"!

IRE/IREE association

For me, contact with Murray Stevenson was most frequently through the IRE (Aust) — later the IREE (Aust) — where he built up an outstanding record of voluntary service.

As Chief Engineer of 2UE, he became a corporate member of the IRE in May 1934, at a time when the IRE itself was very young.

In 1940 he was elected to the (national) Council, the IRE's governing body, and remained a councillor for the next 34 years, by election or ex-officio. For extra measure, he served as Chairman and Honorary Secretary of the Sydney Division for terms during the 1940s.



Fig.4: Raymond F. Guy, President of the IRE (USA) welcomes delegates to the 1951 New York Convention, framed by a huge replica of the Institute's motif. Sharing pride of place at the very top with the Stars and Stripes was the Australian flag.

Murray became Vice President of the IRE (Aust) during 1946/47, Senior Vice-President 1947/48 and President 1948/49. He also served on a number of IRE/IREE (Aust) committees and boards until 1981, notably: Publications Board 1948-78; Qualifications Board and Education Board 1936-49; Education 1961- 70.

It was on the Publications Board that I got to know Murray best, at a time when he was also acting as Hon. Editor of the IRE (Aust) *Proceedings*.

To be sure, papers submitted for publication were scrutinised by independent referees for both expert and broad content and appeal, but it often fell to Murray as Editor sort out differences in perception between authors and reviewers, finalise the contents of each issue and check the layout and presentation of each article.

In a recent conversation, Murray told me how, during one of his visits to the USA, he had a session with Dr Alfred N. Goldsmith of the American Institute. When he confided to Dr Goldsmith that he found the role of Honorary Editor something of a burden, on top of his other duties, Dr Goldsmith indicated that, as Editor of the American *Proceedings*, he understood the problem only too well.

He went on to offer publication rights to all original papers in the American journal to its Australian counterpart, requiring only that the source and authors be formally acknowledged.

He further suggested that the IRE (Aust) respond by granting the IRE (USA) reciprocal access to Australian papers. Murray was only too happy to agree.

Looking back to my own experience on the Publications Board, I can recall many occasions when hassles over a local paper created a 'hole' in an up-coming issue, which we were only too glad to fill with an American paper that someone had found interesting and appropriate for local consumption...

During one American visit, Murray was requested by the IRE (Aust) President and Council to represent the Institution at the IRE (USA) Radio Engineering Convention, New York, during February/March 1951. Sir Ernest Fisk would also be present (Fig.3).

Said Murray: "What I saw when I walked into the Convention, and what I still vividly recall forty years later, was the Australian flag at the very top of the IRE motif, sharing pride of place with the Stars and Stripes!"

And there we must leave Murray for the present. Next month, we tell how he had to enlarge his technical horizons to embrace the establishment of a major television station and film/video production centre.

(To be continued) ❖

THE SERVICEMAN

When something that's cheaper can turn out to be more expensive...

This month I have a real grab-bag of stories for you. They cover all kinds of problems, from new equipment design to misleading PCBs and faults that even the manufacturer's service department agrees are insoluble. There's even a follow-up, on the subject of mixed-up part numbers that confound and confuse.

We open the account by welcoming a new and potentially prolific contributor to our ranks, who works not in the domestic electronics field but in the security industry. Electronic alarm systems have been around for a quite a few years now, but apart from the need to track down the occasional false alarm problem, security systems have not generated many stories about servicing the equipment, as such. Until now, that is...

Our new contributor is A.L., of Beverly Hills in New South Wales. He doesn't tell us where he stands in the security system heirarchy, but his stories suggest that he has a somewhat elevated position in the design team. Certainly, his stories tell of problems more in line with system development than with routine service jobs. Nevertheless, the tales are interesting and informative, so I have no hesitation in using them here.

A.L. has sent in three stories so far, but I have elected to present them one at a time. I will mix the others with ordinary tales over the coming months. The first of his stories is one of extreme gravity — he calls it 'The One That Didn't Get Away', and writes thus:

When designing any electronic equipment it is good practice to investigate any inexplicable effects which may be observed when testing the prototypes. This is a case in point.

The design of a self-contained doorway alarm had progressed well and two prototypes had been assembled. The devices were low cost, low current passive infrared detectors which detected the infrared energy radiated by a moving person.

There is an atmospheric window at a wavelength of 9.5 microns, and a human body at a temperature of 37°C radiates at this wavelength. This energy can be focused by a segmented infrared lens onto a pyroelectric detector, and the motion of the person in the optical field of the segmented lens causes chopping of the radiation.

The output of the pyroelectric detector is a low frequency AC signal, which is amplified by a low-pass amplifier. The zero crossings are detected by a double edge detector, to ensure that the signal was caused by the motion of the target and not by a change in the ambient temperature.

The pyroelectric detector selected for this design was a dual-element device supplied by Philips and available in two grades. As low cost was a prime objective in the design and there was a reasonable cost advantage in using the lower grade detector, two prototypes were assembled to evaluate the relative performance of the detectors.

The two units were subjected to sensitivity tests and signal to noise ratio tests (SNR), using a chopped infrared source and the results indicated that the performance of the lower grade unit was acceptable for the application.

Then came an unexpected discovery. As part of the SNR test the noise floor of the units was measured by masking the pyroelectric detector from ambient infrared radiation. In this condition the lower grade detector exhibited what at first appeared to be microphonic noise.

This was checked by subjecting the unit to high level low frequency sound, but there was no detectable output. So much for the microphonic idea; yet if the unit was moved with the detector masked it would go into the alarm state. It was behaving like a gyroscope — i.e., when its orientation was changed it gave an output!

We wondered if the effect might be magnetic. Yet a 20-kilogauss magnetic field was applied and removed with no detectable result.

Could the detector be sensing minute changes in gravity? As the device was self contained, battery powered and gave an audible alarm output, it was a simple exercise to suspend it on a string from a rafter of the workshop. This was done and the unit swung like a pendulum.

Each time the unit passed through the bottom of the arc it triggered. If the string was shortened the frequency and duration of the alarm increased, and if the string was lengthened the frequency and duration of the alarm reduced.

The string was eventually increased to a length of 10 metres, at which point the rate of change in the G force was insufficient to cause an alarm.

The pyroelectric elements in the detector are connected series opposing, to cancel the effect of ambient temperature change. A small mismatch in the response of the elements of the lower

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grade detector made the observed gravity effect noticeable.

From these results it was decided that the cost penalty in selecting the higher grade detector was justified. So by careful analysis of the prototype's performance, we had been able to avoid a potentially embarrassing false alarm problem.

Thanks, A.L. That was quite interesting, and it could explain the reason for other mysterious alarms that go 'Whoo! Whoo!' in the night. It's also a reminder that low initial cost is not always a desirable feature — you only get what you pay for.

And as mentioned earlier, there'll be more stories from A.L. in coming months. Thanks again.

Misleading PCB

Now, a short item from another contributor. This time it's M.C., of Gladstone Park in Victoria. M.C. writes about wrongly marked PCB's and the confusion that can result. It's something that's been discussed in these pages before, but the problem is far more common than the infrequent references here might indicate.

An article you wrote some time ago concerned a problem with incorrect markings on a circuit board overlay which lead to a capacitor being inserted incorrectly. This has prompted me to write about a similar fault I found with a Sanyo 26" colour television, model CTV8653 fitted with a 79P chassis.

This set belongs to my mother, and one morning she rang to tell me that she couldn't understand the television. (Actually, I was not at all surprised, considering her ethnic origins!) However, she sounded to be in some degree of panic so I wasted no time in tending to her complaint.

On switching on the set, a normal picture was presented but the sound was indeed somewhat distorted and also needed significant 'volume' to produce any sound at all.

Since a CRO was not available, I fed an audio tone directly to the audio amplifier IC151 via R159 and when the output was also distorted, I concluded that the fault lay somewhere in the amplifier itself and not in any preceding circuitry.

The first components I thought to check were the electrolytic capacitors C151 (supply bypass capacitor), C154 and C157 (DC blocking capacitors). I found C154 to be dried up and C157 to be leaking electrolyte. C151 appeared to be OK.

"Simple fault and easy fix!" I thought, and after replacing the faulty capacitors and rechecking my work, I switched on the set. But I hadn't considered the machinations of Murphy. While looking into the back of the set, I noticed a thin wisp of smoke curling up from R153.

I switched off quickly and found R153 to be open circuit. The next half hour or so was spent checking the transistors Q151 and Q152, the 220V supply and some associated diodes for any trace of shorts or leakage. But everything checked out OK!

Although I had previously looked for a short on the 220V supply, I had checked from the collector of Q151. This time I checked across C151, and found a dead short to ground.

On taking a closer look at the capacitor, I realised that it was fitted the wrong way round — negative terminal to positive rail. In fact, when I had removed the capacitor to test it, I had replaced it according to the screen printed overlay on the top of the board. But this was printed back to front!

When I reversed the capacitor and replaced R153, I switched on and the set came good with a good picture and normal sound.

So your experience with that other TV was not a one-off. Other manufacturers have made the same mistake. I wonder how many other sets have been written off because of a simple printing error like this...

Thanks, M.C. Your story is the first time I've heard of a Sanyo overlay being wrong, but as mentioned above the problem is fairly common.

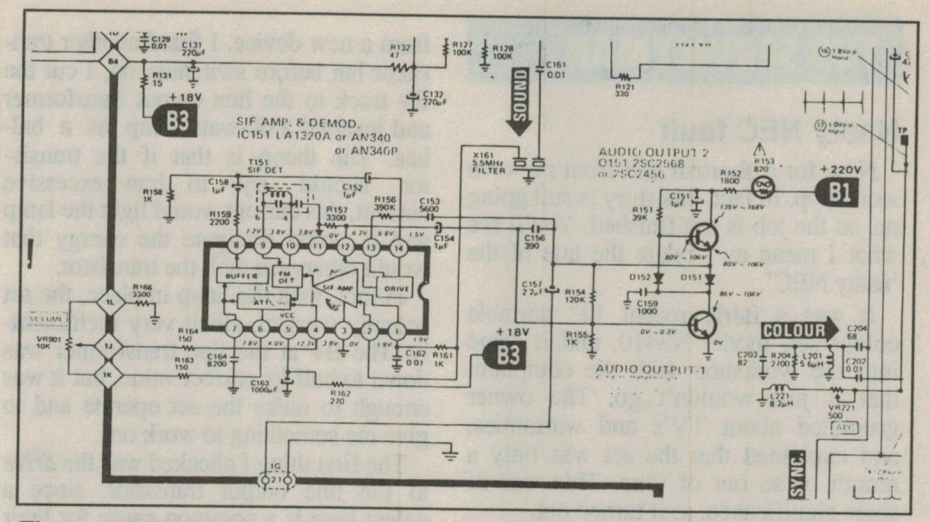
Having diodes and electros shown wrong way around is probably the worst types of printing errors, but I've found resistors shown as C something and capacitors as R ditto. And even when they got the prefix right, I've found things like R296 really being R396. Which doesn't help at all in finding the right component!

But in fairness, there is one thing I have to say. These sort of mistakes rarely appear in sets bearing reputable brand names such as Sanyo. The faults are more often than not in the 'discount' brands.

It stands to reason. If a manufacturer builds 10,000 sets before a mistake in the overlay is discovered, it's cheaper for him to job them out to a discount brand reseller than it is to try to correct the error by re-manufacturing the boards.

I've said before that you get what you pay for; but in this case, it seems that we get lumped with what the customer pays for!

Anyway, thanks again, M.C. We hope that your mother appreciates your prompt and efficient attention!



The sound IF, detector and audio section of a Sanyo CTV 8653, fitted with a 79P chassis. Contributor M.C. struck trouble fixing a sound fault in one of these sets, due to a wrong component polarity marking on the PCB.

Fault of the Month

Sanyo 79P chassis

SYMPTOM: Intermittent loss of vertical hold. It was susceptible to both physical and thermal shocks — either would start the gyrations.

CURE: R437, a 33 ohm two-watt resistor, was defective. This resistor is associated with the side pincushion network, and it's hard to see any connection with the vertical hold circuitry.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

Nasty NEC fault

Now for a shortish tale from my own workshop. In fact, this story is still going on, as the job is not finished. You'll see what I mean as I relate the tale of the 'nasty NEC'.

It was a fairly recent 12" portable colour set, model N3410, and it came into the workshop with the complaint that it just wouldn't go. The owner grumbled about TV's and warranties, and explained that the set was only a month or so out of time. This was of some significance, as it turned out.

On the bench, I soon learned that the reason for the no-go was that the line output transistor was short circuited. I checked all the likely causes for the short but, finding nothing suspicious, fitted a new transistor and switched on. The sound and EHT came up straight away, but before the tube had time to warm up the new transistor gave up the ghost. Except that it wasn't quite a dead short as before, but just very leaky.

Of course this was very discouraging, since these transistors (2SD1554) are moderately expensive — and one does expect a bit more than 15 seconds life from a new device. I fitted another transistor but before switching on, I cut the B+ track to the line output transformer and inserted a 60-watt lamp as a ballast. The theory is that if the transistor should try to draw excessive current, this current would light the lamp and it would dissipate the energy that would otherwise melt the transistor.

In fact, with the lamp in place, the set actually worked, albeit very inefficiently. The B+ at the line transformer was down to half its correct value, but it was enough to make the set operate and to give me something to work on.

The first thing I checked was the *drive* to the line output transistor, since a defect here is a common cause for their destruction. There are no waveforms given in the manual (although there are numbers at all the relevant points which suggests that waveforms are somewhere available!), but line drive waveforms are rather standard and I found no discrepancies in this set.

So I shifted my attention to the output side of the transistor, and here I struck it lucky. The waveform at the output transistor collector should be a single, narrow, high voltage spike, with almost no ripple on the trace between successive pulses.

In this set, the pulse was there alright, but was followed almost immediately by another pulse at about half the amplitude.

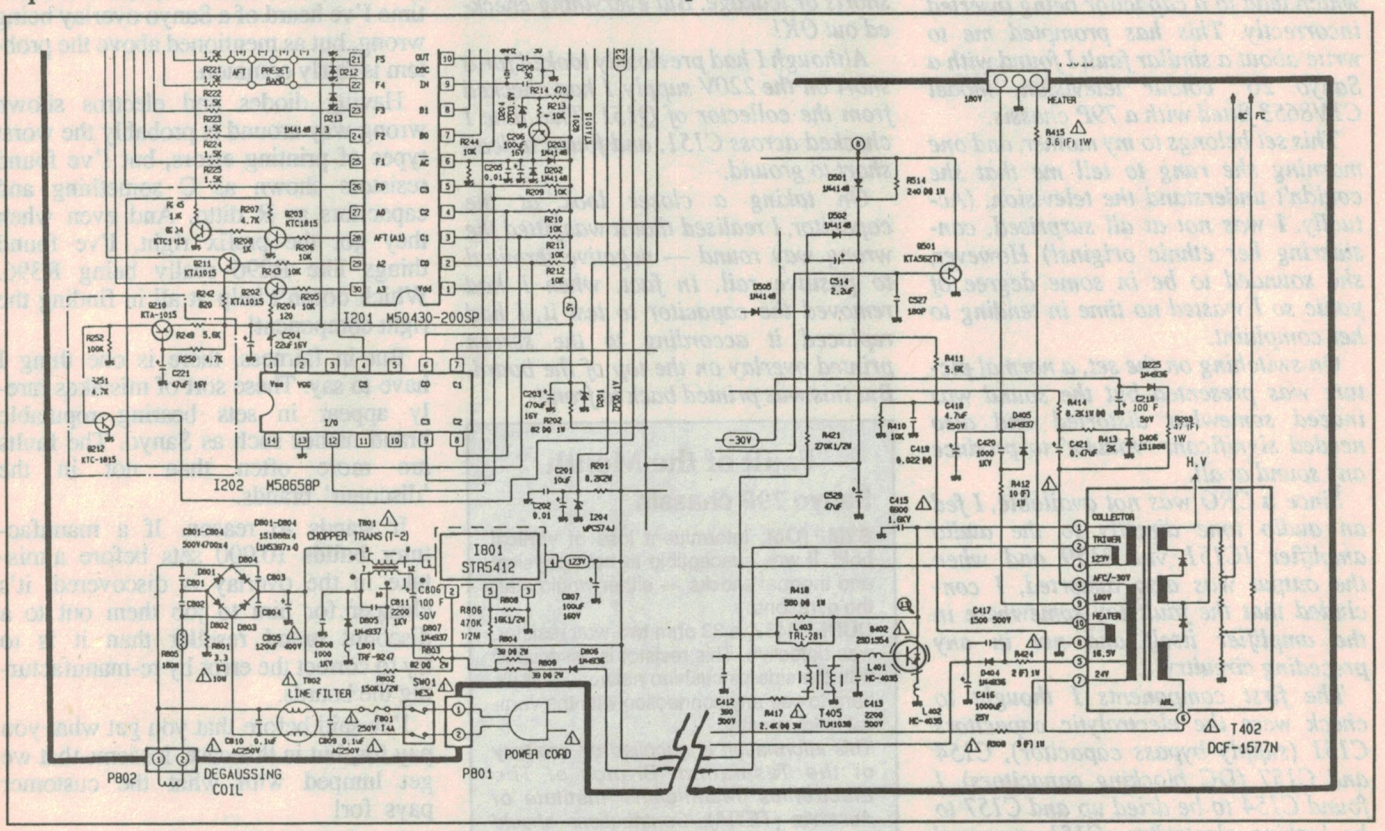
I had seen this characteristic before, and it always preceded the discovery of a faulty line output transformer. This was to be no exception, because after about five minutes, the transformer began to smell rather badly and was uncomfortably hot to the touch.

This set was made in Korea for NEC, and is substantially the same as the chassis in a number of other brands. Replacement transformers are readily available and are relatively inexpensive. So a new unit was ordered and subsequently fitted.

It should be noted here that the new transformer was indistinguishable from the original. It carried the same maker's name and part number, and was identical to the original in every respect that I could determine. Except that when I powered it up, a puff of smoke arose from the vicinity of the power regulator chip! Two small resistors had given up their lives, rather violently.

The resistors were R804 and R809, a parallel combination of two 39-ohm two watters, in the 'trigger' circuit between the line output transformer and the chopper power supply chip.

Continued on page 48



The power supply and horizontal output sections of an NEC model N3410 colour TV, which forms the subject of our Serviceman's own story this month. Like a few other examples of this model, the set concerned keeps on burning up a couple of resistors since the EHT transformer was replaced — and no one seems to be able to explain why!

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Continued from page 46

I replaced the resistors and reconnected the ballast, except that I increased the wattage of the lamp to 150. This reduced the voltage drop at the line output transformer, and allowed the set to work well enough to display a small picture. In this condition I was able to check voltages and waveforms throughout the set, and I could find nothing that couldn't be explained by the presence of the ballast lamp.

The only thing that looked a bit odd was the 'trigger' pulse from the line transformer, which feeds through the two resistors that were burning up. This pulse was a bit wider than I would have expected and had a somewhat rounder top to it. However, it was a clean and regular pulse and I wouldn't have thought it energetic enough to burn up four watts' worth of resistors.

After checking everything around the line output stage, and the power regulator stage, I had to conclude that the only thing left unchecked was the regulator chip — an STR5412. This was best checked by replacement; and with only five pins, it didn't take long to prove that there was nothing wrong with that item either!

Which left me in a bit of a mess. Every time I removed the ballast lamp, the resistors burned up. I couldn't return the set with a 150-watt lamp hanging out the back of the cabinet, and a three-quarter sized picture on the screen!

I had to complete the job, or I would lose the parts I had already fitted plus the time I'd put into it. I decided to swallow my pride and approach a colleague who does NEC warranty work.

As I described the problem so far, I got to the part where I had fitted a new transformer and he finished my sentence for me: "...and two resistors burned up?" It was pretty obvious that I wasn't the first serviceman to strike this trouble. It appears that while these sets were still under warranty, it had several times become necessary to change the line output transformer. And each time the transformer was replaced, the two resistors burned up.

On one occasion, a good transformer was taken from another set and used to replace a faulty unit. The resistors burned up. Yet when the transformer was returned to its own set, it worked perfectly.

Later, a replacement transformer was tried in the good set before being fitted to the faulty one. It worked perfectly in the good set, yet burned the resistors when refitted to the dud one. Which implies that the fault can't be the transformer...

So the fault lies in the set itself, not in the transformer. Yet no one that I know has been able to find it. As a last resort, I faxed the NEC service manager and asked if he could help me. His reply was, effectively, "If you ever find out, please advise us!" It would seem that *they* have several of these sets — all returned under warranty, all with the same fault and all defying solution.

If this job had come in a month or two earlier, while it was still under warranty, I could have shot it back to NEC and saved myself $100 in parts and time. And that's not to mention the aggro from an irate customer.

It's the last N3410 I'll ever touch, and I suggest you adopt the same philosophy. At least until the true cause is found!

When your TV fails...

1. Don't request service until all family members and friends have formed an opinion about what's wrong.
2. Every available control should be reset.
3. After a few days when the fault has become a major crisis, put in an urgent call for service. Friday is best, but any time after 4.00pm is OK.
4. Hide paperwork relating to purchase of the TV or any earlier repairs.
5. Mention the tech who was here for the same problem last week.
6. The minute the technician arrives, ask what caused the delay. Make it clear that you expected service two days ago. Before the technician can answer, ask when the TV will be working again.
7. The TV should be as dirty, dusty and unpleasant to work on as possible. A mixture of cigarette tar, cockroach cases and cat urine works well.
8. Ask again when the set will be fixed. Good timing is essential, and when the set is in a million pieces is best.
9. Offer to switch the mains on "Now?"
10. Ensure that the TV is in the loungeroom's darkest corner, with lighting as dim as possible. Good technicians can work blindfolded.
11. When the technician looks at the schematic diagram, ask if he knows what he is doing. Mention that you repaired the toaster last week, without the aid of a schematic diagram.
12. When the technician's head is buried deep in the cabinet, have five year old Johnny whack the side with his hammer. Technicians should stay ALERT!
13. Claim warranty. Change the '7' in '1972' on your purchase docket into a '9'. Crayon through the serial number will help confuse the issue.
14. Mention your invalid pension and try to lower the bill. Technicians make too much money, anyway.
15. Before the technician leaves, unchain 'Sargent'. Find out if that $500 you spent sending him to that Attack Training Course was good value or not.

(Contributed by Kim Taylor, K.T. National, 1 Hobart Road, Youngtown 7250)

Sony chip footnote

Now, to end this month's column, here's a footnote to a story I presented a month or so back, about Thorn and Sony televisions that used the TDA3562 as a vertical output chip. That story suggested that there was some difference between the chip as presently marketed and the chip with the same number as originally fitted to the sets.

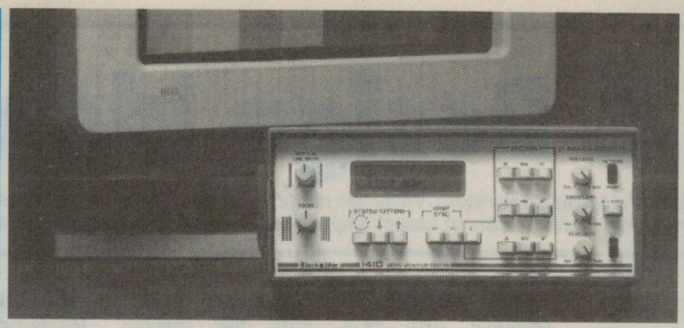
Since then I have learned about a modification issued by Sony concerning this chip. The notes claim that the TDA3652 is 'no longer available' and proceeds to detail the mods needed to use the TDA3654 as outlined in my story.

However, *we* know that the TDA3652 *is* still available, even though it won't work in place of the original. This suggests a possible scenario for the cock-up. I suspect that a whole batch of chips were wrongly numbered; they were released as TDA3652's, but should rightly have been something quite different.

This accounts for why Sony would list them as no longer available. It would also free the number for re-use on a totally different chip — the one that caused all the aggro in our earlier story. Of course, this is all guesswork, but there definitely is something funny about the TDA3562, old and new. Incidentally, the Sony modification calls for R518 to be changed to 1.5k ohms, not to 3.3k ohms as given in our story. However, the 3.3k seems to work quite well, so there is no need to worry that any modified sets need to be changed again.

Well, that wraps up the column for this month. But there is still plenty of material ready for next time. So don't go away! ❖

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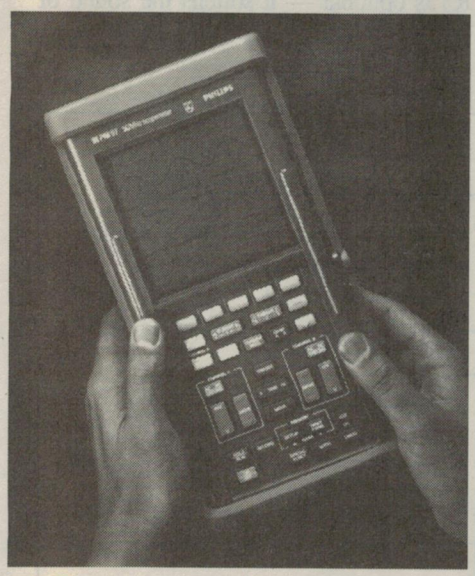
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Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Blinker reminder

Here is a refinement of the audible turn indicators, which I have fitted to my Toyota Camry. The unit has a long delay, followed by a short on-time, which I find is ideal for my use.

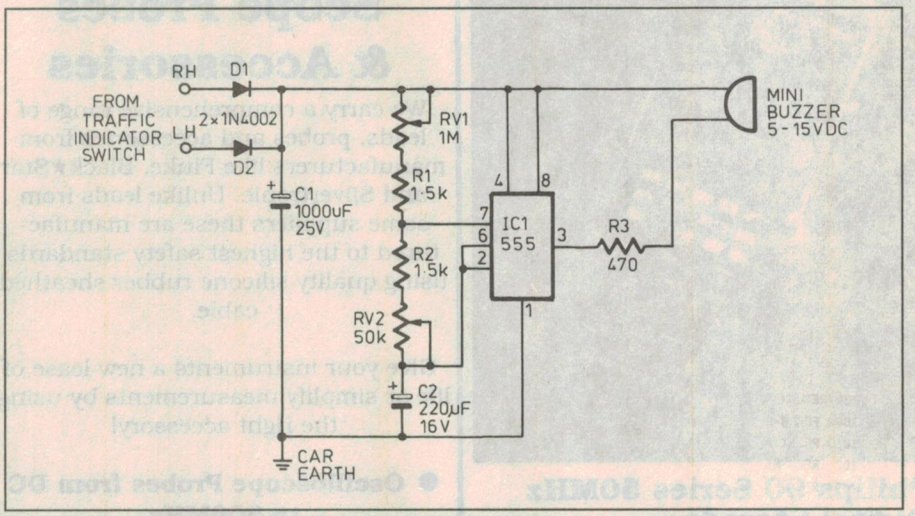
I don't really want to know that the trafficator is working, but I *do* want to know if they have failed to cancel. For me, simply amplifying the sound was not the answer.

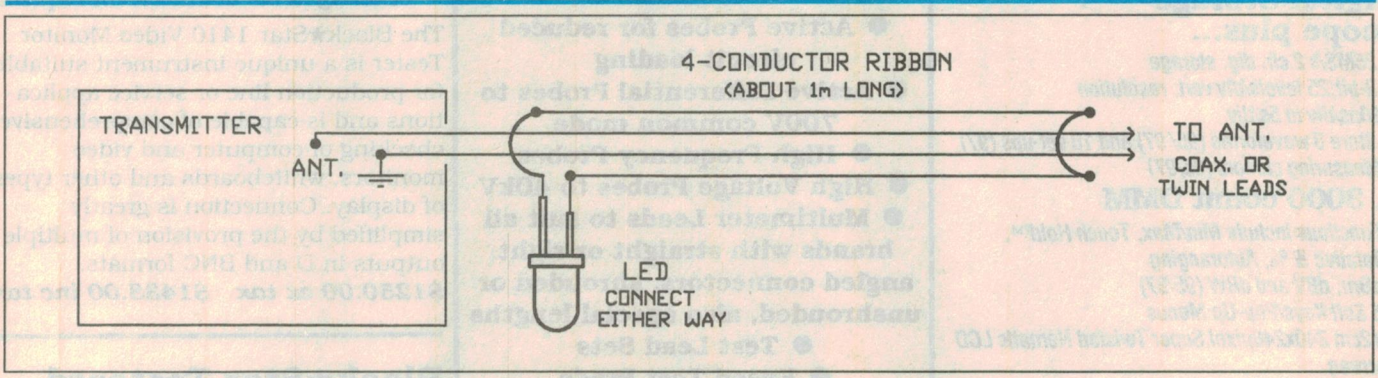
If either the left or right blinkers are on, capacitor C1 charges up via diodes D1 or D2, and maintains the supply rail voltage for the timer built around the 555 (IC1). The 555 is wired up as an astable multivibrator, with a long charging time and a short discharging one.

With trimpot RV1 set to about 400k and RV2 set to about 15k, the delay time before giving you a reminder is over one minute, with the buzzer being on (output pin 3 low) for about three seconds.

I built the unit on two small pieces of matrix board, fitted into the slots on the smallest jiffy box, with the buzzer mounted on the lid. The two wires to the L and R trafficator switch were cut, then rejoined on a terminal strip, with the new wires running out to the jiffy box. Resistor R3 is optional — it softens the sound of the buzzer.

Glyn Shepherd,
Penshurst, NSW **$40**





Transmission indicator

This simple circuit uses a four conductor piece of rainbow ribbon cable and a LED as an RF output indicator for low power transmitters. A 1m length, or a bit less, is suitable for 5W CB rigs on 27MHz and for the 10-12W outstation rigs used in PNG on 2-6MHz. For other power levels and frequencies, users should scale the length of the ribbon up or down.

The two centre conductors of the ribbon cable are the transmission line — I believe that they will be between 50 and 80 ohms balanced for most common types of rainbow ribbon.

The ribbon is rather limited in power handling ability, though, unless heavy duty types are available. You would expect such ribbon to be low-loss at radio frequencies, since it is used to carry RF in computers. It doesn't increase the SWR at the frequencies that I use.

The two outer conductors are in the best position for power picup, going and coming, if the ribbon is kept flat and fairly straight. I have tried a number of different size and colour LEDs, and they all worked — the best being a plain 1.6V red. Do not connect a signal diode back-to-back for RV protection — the 4pF or so capacitance drops the voltage enough to cause the LED to go out. Although the PRV for most LEDs is around 4V. I haven't blown any yet. If you are running higher power, you may want to try a diode, but it would be better to just shorten the ribbon length.

This simple gadget really works! You only get the LED to light if you have real RF current flowing.

Often small rigs with built-in antenna tuners, with a light or tiny meter to indicate resonance, can indicate full power output without a bit of power going to the antenna. Even with a SWR meter and a proper transmatch, I have found at times that all the power was being used to heat the transmatch coils. Putting this 'power' LED between the transmatch and the antenna will tell you the truth.

With a power consumption of about 0.01W, you can solder it permanently in the transmission line, or you can dress it up with co-ax connectors at both ends.

Rev. H. Fischer,
New Ireland, PNG **$35**

DMM battery saver

The simple battery saver described in the January 1993 issue of EA attracted my attention because I had been toying with the idea of inserting such a circuit within my portable DMM.

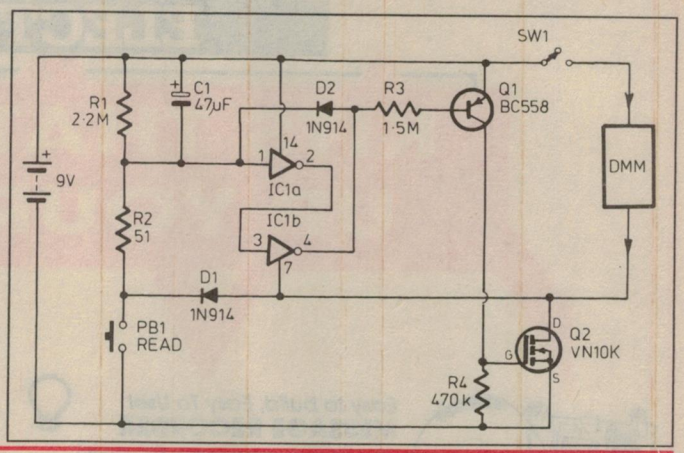
The original circuit traverses slowly from the low to high resistance states, and this rate is also influenced by the load on the FET. Another drawback is that the threshold varies from 0.3 to 1.5V, depending on the gate turn-off valve of the type of FET used.

My modifications improve the design by giving a rapid switch action and a more definite turnoff threshold for the FET. These improvements are gained by using two of the Schmitt trigger gates on a hex inverting 74C14 chip (IC1). Integral to these gates is a well-defined and temperature-compensated switching threshold. This gives a high impedance RC timing, with t=1.13*R1*C1. Diodes D1 (for switching 'on') and DC (for 'off') are needed to ensure rapid switching of the gates.

The values of resistors R3 and R4, and transistors Q1 and Q2, allow Q2 to be either a FET or a bipolar transistor to handle any magnitude of load.

In the circuit shown the VN10K of the original circuit was retained for its low on-resistance — which resulted in a 18mV drop for my DMM. The extremely low 'off' battery drain was not measurable on my meter.

D.S. Chambers,
Waterford, WA. **$40**



Eight bit PWM

This circuit uses pulse width modulation (PWM) to control a new type of linear water valve which had to be run from a DC supply. The valve was designed to be operated by a 'phase cut' (the manufacturer's way of saying 'phase-angle fired') 20V DC, 50Hz SCR controlled source.

The pulsing 50Hz makes the core of the valve bob up and down ever so minutely to overcome static friction, so that, as you make small changes to the firing angle, the valve should open and close accordingly. This is fine if you can plug into the mains grid, but where this project was going to be used, +27V DC was the only power supply available. So the logical answer was to use PWM. Ultimately, this would be generated by an embedded controller, but to test the valve for linearity, reliability, etc., the following circuit was developed.

It consists of an eight bit synchronous counter IC1 (4520), driving two four bit comparators IC2 and IC3 (4585). The output frequency = clock/256, so for a 50Hz output the clock will need to be 12.8kHz. The clock may be supplied by a 555 or Schmitt logic gate oscillator.

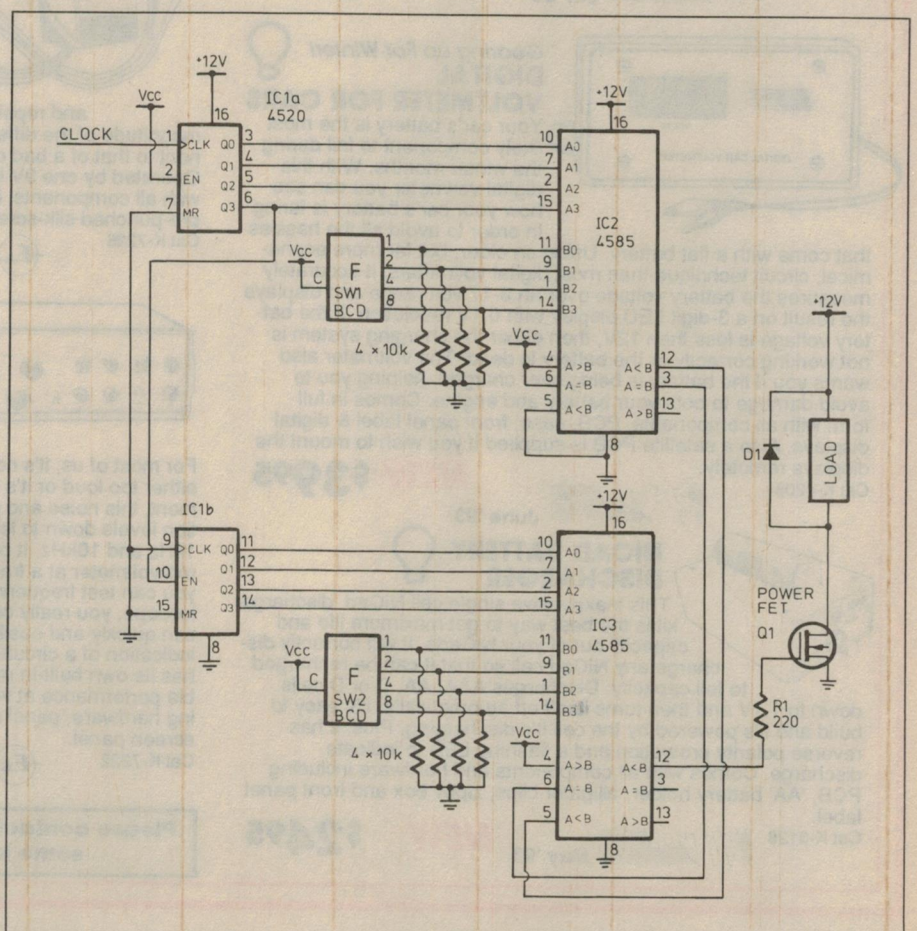
The duty cycle is set by selecting the appropriate eight bit hex word on the BCD thumb wheel switches. Thus the duty cycle = switch setting*100/256. Note that the maximum setting is FF hex, so the duty cycle ranges from 0% to 99.6%. You should not substitute a ripple counter such as a 4060 for IC1, as you will generate false codes which will produce hash at the output.

Not shown in the schematic, but required, is to pull all the output lines of SW1 and SW2 to ground via 10k resistors.

The circuit should be operated from 12V DC, so that the N-channel FET (Field Effect Transistor) may be directly driven by the output of IC3. The switching time of the FET is around 50us, so if you require faster times, you will need to buffer its output. If the FET does not have an inbuilt drain-source zener diode, then you should supply one externally. Diode D1 is used to suppress flyback of an inductive load.

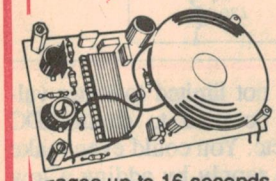
The circuit is not limited to water valves, but could be used to control DC motors, lights, etc. You could even make a digital power supply by adding a low pass filter to the output, and use a computer instead of thumb wheel switches for PWM control. (But remember to match the logic levels!)

Leigh Bateman,
Flaxton, Qld. **$45**



DICK SMITH ELECTRONICS

KITS THAT'LL SPARK UP YOUR WINTER!

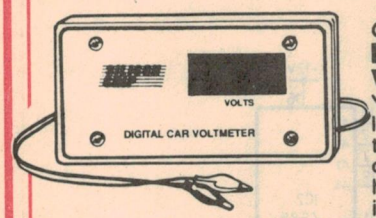


Easy to build, Easy To Use!

MESSAGE RECORDER

Now, there's no need to frantically search for a pen every time you want to leave a message for someone! Build this kit and record your important messages. Using a single chip, it records voice messages up to 16 seconds and retains them even through power failures. Incorporate the message recorder in your own designed projects, so instead of receiving a beep or having a flashing LED as a warning indicator, your pre-recorded message will alert you. It's an easy-to-use kit with two-button operation. Comes in short form, with all components, PCB, hardware including speaker and mic insert.

Cat K-5018 — Jul '93 — **NEW** **$39.95**

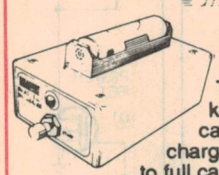


Gearing up For Winter!

DIGITAL VOLTMETER FOR CARS

Your car's battery is the most likely component to fail during the winter months. With this digital voltmeter you can see how your car's battery is faring in order to avoid all the hassles that come with a flat battery. Using an older, but far more economical, circuit technique than most digital voltmeters, it accurately measures the battery voltage over an 8-17 volt range and displays the result on a 3-digit LED display with 0.1V resolution. If the battery voltage is less than 12V, then either the charging system is not working correctly or the battery is dead! The voltmeter also warns you if the battery is being over charged, helping you to avoid damage to both your battery and engine. Comes in full form with all components, PCB, case, front panel label & digital displays. Also a satellite PCB is supplied if you wish to mount the displays remotely.

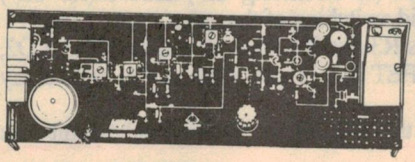
Cat K-4208 — June '93 — **NEW** **$39.95**



NICAD BATTERY DISCHARGER

This inexpensive single cell NiCad discharger kit is the best way to get maximum life and capacity out of your NiCads. It will correctly discharge any NiCad cell so that it can be recharged to full capacity. Discharges AAA, AA, C or D cells down to 1.1V and then turns itself off automatically. It's easy to build and it's powered by the cell it's discharging. Plus, it has reverse polarity protection and a flashing LED to indicate discharge. Comes with all components and hardware including PCB, 'AA' battery holder, alligator clips, zippy box and front panel label.

Cat K-3128 — May '93 — **NEW** **$24.95**

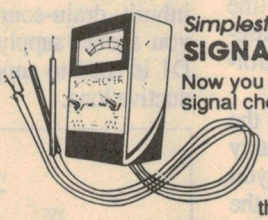


Ideal Learning Aid!

READY-TO-BUILD AM RADIO TRAINER

Teaches you, your kids or your students the basic principles of how a superheterodyne radio works. It's built with easy-to-get parts and everything is mounted on a single PCB with the circuit diagram screened onto the component side of the PCB so assembly is a breeze. Supplied with all components PCB and hardware.

Cat K-5016 — July '93 — **NEW** **$39.95**

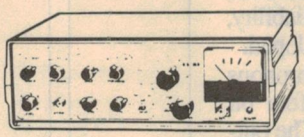


Simplest Signature Analyser Yet!

SIGNAL CHECKER

Now you can build your own simple cost-effective signal checker! Without being as complex as traditional models, this compact version can compare circuits point by point. If you have a faulty board and a good board for comparison, you can easily find the bad components that are out of spec and repair the board. The Signal Checker integrates the magnitude of the difference between the signature of a good component to that of a bad one and displays it on a meter reading. Operated by one 9V battery (not included) and comes in full form, with all components, hardware bits, panel meter, PCB, zippy box, pre-punched silk-screened front panel and test probes.

Cat K-7226 — EA — July '93 — **NEW** **$39.95**



Outstanding value!

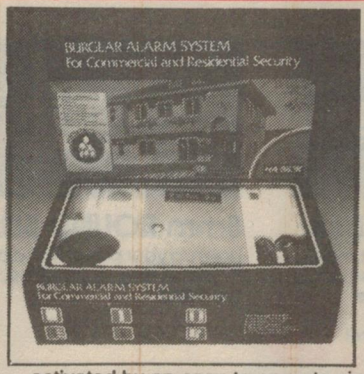
LOW COST NOISE AND DISTORTION METER

For most of us, it's not difficult to measure noise and distortion - it's either too loud or it's not! But for anyone involved with audio equipment, this noise and distortion meter is a must. It can measure distortion levels down to less than 0.01% at spot frequencies of 100Hz, 1kHz and 10kHz. It provides a built-in low-distortion meter and AC millivoltmeter at a fraction of the cost of commercial models. Although you can test frequency response using an audio oscillator and oscilloscope, you really can't check output distortion. With this meter you can quickly and easily measure the THD for a much more reliable indication of a circuit's performance under steady-state conditions. It has its own built-in reference oscillator and delivers more than credible performance at very low cost. Comes with all components including hardware, panel meter and deluxe case with pre-punched silk screen panel.

Cat K-7222 — EA — June 93 — **NEW** **$129**

Please contact your nearest store for availability as some kits may still be in production.





Big Protection On A Small Budget!

AFFORDABLE HOME SECURITY SYSTEM

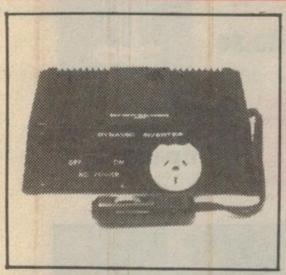
You don't have to spend a fortune to protect your home! Security is yours with this affordable system - it covers the average home and can be easily upgraded to suit your future requirements. It's activated by an easy-to-operate single key, includes a passive infrared sensor (PIR) for area surveillance, five pairs of magnetic switches for use on doors and windows, plus a panic button that trips the alarm instantly, an external horn siren and plug in power supply. You can install it yourself using the easy to follow, step-by-step instructions supplied.

Features:
- High quality 3-sector alarm panel
- Easy-to-use 1-key activation
- Passive Infrared area sensor
- 5 pairs of magnetic switches for windows and doors
- Panic button and mains power adaptor
- Comprehensive, step-by-step installation instructions

Cat L-5142

NEW

$229



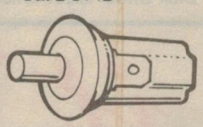
12-240V 200W INVERTER

A compact, advanced power system providing 230V AC from a 12V DC source. It will operate most low powered, electrical equipment, including smaller televisions and VCRs, personal computers, small kitchen appliances and cam-corder and cellular phone chargers.

DC input Input Voltage:	10.7-14.5 (12V nominal)
AC Output Voltage:	230V RMS
Output Frequency:	400W (surge), 200W (40 minutes), 160W continuous
Dimensions:	182(h) x 105(w) x 60(l)mm
Weight:	1.1kg

Cat M-5010

NEW **$249**

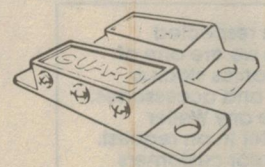


ALARM TAMPER SWITCH

Ideal for protecting alarm panels and siren covers - it detects if they've been tampered with and triggers the alarm. Can be mounted to most alarm systems on a normally-closed circuit.

Cat L-5286

$2.95



REED SWITCH

With both N.O and N.C contacts. For easy mounting, it is encased and double-sided tape and screws are provided.

Cat L-5211

NEW

$5.95



SAFETY SWITCHES

Ideal for the work bench or for domestic appliances. These safety switches prevent electrocution by automatically cutting off power from your appliances within 30 milliseconds. 10A rating.

Unit that wires to existing cord.

Cat M-7291

$29.95

Simply plugs in.

Cat M-7292

NEW **$39.95**



Excellent Value For Your Money!

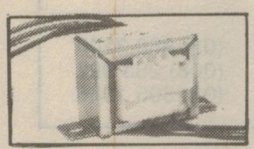
AUTO/BOOST 6A BATTERY CHARGER

A rugged battery charger with an easy-to-read LED display. Suitable for 12 volt batteries used in cars, caravans and boats. It has an automatic charging mode to hold batteries at full charge and a condition analyser function.

Cat M-9806

NEW **$69.95**

LATEST RELEASE! NEW TRANSFORMERS.

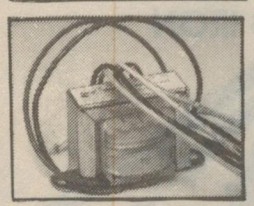


30V CT + 36V CT @ 140mA TRANSFORMER

Secondary Voltage: 18-15-0-15-18V
Secondary Current: 140mA
Terminations: Flying Leads
Dimensions: 35(h) x 44(w) x 42(d)mm

Cat M-2856

$8.95

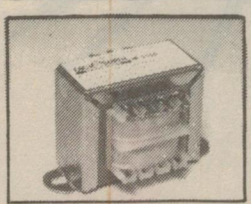


30V CT + 15V CT@ 500mA TRANSFORMER

Secondary Voltage: 15-7.5-0-7.5-15V
Secondary Current: 500mA
Terminations: Flying Leads
Dimensions: 50(h) x 61(w) x 44(d)mm

Cat M-2860

$14.95

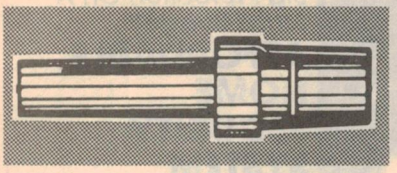


6.3-15V @ 2A TRANSFORMER

Secondary Voltage: 6.3, 7.5, 8.5, 9.5, 12.6 & 15V
Secondary Current: 2A
Terminations: Solder Lugs
Dimensions: 60(h) x 70(w) x 68(d)mm

Cat M-2156

$16.95

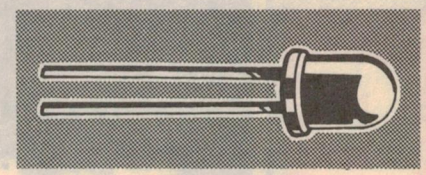


INLINE 3AG FUSE HOLDER

A 12 volt fuseholder just like our standard P-7912 but this one has no cable attached. All necessary connecting hardware (contact studs, tension spring) are included. Simply add your own wire!
Cat P-7911

NEW

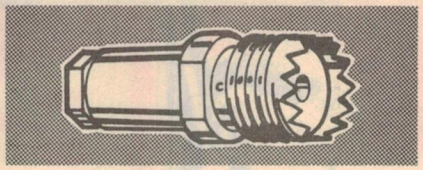
85¢



5mm ROUND BLUE LED

Light up your panel with a blue LED. Rated at 3V 30mA and at a low price!
Cat Z-4005

$3.25

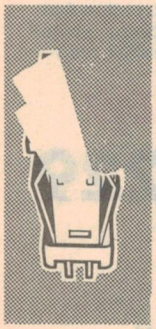


INLINE UHF SO239 SOCKET

With gold flashed centre and teflon insulation. To suit RG58C/U and RG59/U.
Cat P-2320

NEW

$6.95



Switch On!

MINI SWITCH

A new square push-on/ push-off switch with flat top. It's 11 x 12.5mm with a clearance depth of 32mm and an electrical rating of 240V AC. @ 1 amp.

Black Cat P-7540
Red Cat P-7542

$2.95

Have you tried our new range of Multilayered Polyester Film MKT Capacitors yet?

They are all rated at 100V 5% (except for the 1.0mfd & 1.5mfd, rated at 63V 10%) and they offer high quality in a small package with a uniform leg spacing of 5.02mm. From the French company -SGS-Thompson, these capacitors allow you to construct circuits that are far more compact than the normal 'Greencaps'. Values from 0.001mfd to 1.5mfd are available at all Dick Smith Electronics stores.

RADIO/TV/RF

MK 484 AM Radio Receiver, T092. Similar to the ZN 414 and available at a lower price than in 1989! See your nearest store for data!
Cat Z-6525

$3.95

10 Up $3.36



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Quality Endorsed Company
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Standards Australia

Weller are well established and much respected manufacturers of top quality tools. As we are one of their key distributors, Dick Smith Electronics stock a comprehensive range of Weller tools and accessories. You can be assured that if you require any Weller product that is not in stock we will order in on request. Plus, we offer wholesale pricing for major customers through our commercial division. Here is just a sample of our Weller range - come and see us at Dick Smith Electronics for more!

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or Australia wide	(008) 263 922
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WELLER WTCP SOLDER STATION

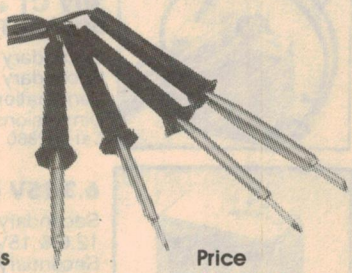
$179



Weller is the first choice of many hobbyists, technicians and service people. Design features such as the non-burning silicon rubber soldering pencil lead, long-life iron plated tips, lock slots on both sides of the soldering iron stand and wick fed tip cleaning sponge make Weller a name you can trust. 48W Max, 24V output
Cat T-3000

MARKSMAN SOLDERING IRON

A top quality range of general purpose Marksman soldering irons suitable for light range to heavy soldering work. They are mains powered and incredibly efficient with impact and heat resistant handles and replaceable nickel and iron plated tips. They also feature stainless steel barrels and ceramic filled elements for greater stability.



Watts	Irons	Price
15W	Cat T-1310	$32.95
25W	Cat T-1400	$49.95
40W	Cat T-1404	$54.95
80W	Cat T-1315	$64.95

NOTE: 120W,175W & 250W Irons are available by order

WELLER EC 1001D SOLDER STATION

$299



The ultimate in controlled temperature soldering. A high quality mains powered soldering station. The tip temperature is electronically controlled between 177°C and 454°C and calibrated to within 6°C. A platinum sensor, ensures dynamic response to load variation and a thryistor drive eliminates high voltage spikes or magnetic fields from the tip. Plus, other safety features ensure safe soldering for sensitive and expensive electronic circuits. Complete with power unit and inbuilt transformer, soldering iron, cleaning sponge and detachable iron holder.
Cat T-3050

Get Into Radio!

CB HANDBOOK

Tom Kneitel



$39.95

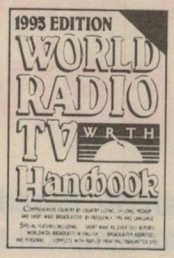
The world's most widely read CB expert's guide to AM and SSB CB operations. This 221 page, fully illustrated book tells you how to get the most from your CB. Includes CB Handles; their meanings and uses, the best operating techniques for AM, special SSB protocol, a complete CB jargon dictionary, equipment, troubleshooting and more. The one book all CB'ers should own!
Cat B-2500

WORLD RADIO TV HANDBOOK 1993

Save $5

$34.95

(June only)



The ultimate directory of international radio and television. Gives complete listings including frequencies, addresses, call signs station identification and transmission times. There's even a special feature on how to convert local time against UTC.
Cat B-2093

PASSPORT TO WORLDBAND RADIO '93

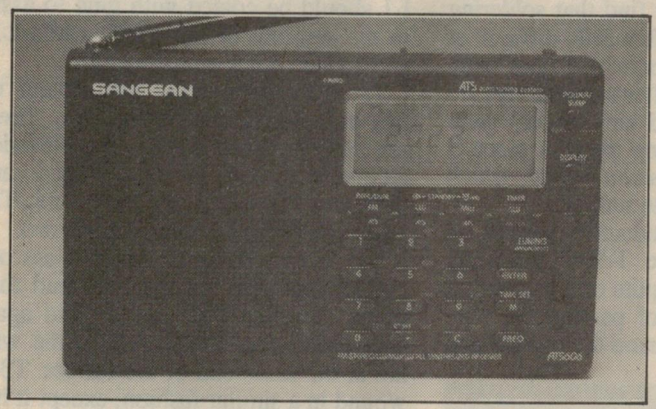
Save $5

$34.95

(June only)



This book is imperative for anyone who's getting started with a shortwave receiver. It's the latest 1993 edition and it includes all the changes that have taken place in Europe and Russia. If you want to know what's on shortwave radio, the best and worst radios, how to get the most from your shortwave listening and more, it's all here.
Cat B-2052



With Auto Tuning!

COMPACT 45-MEMORY SHORTWAVE RECEIVER

SANGEAN

Listening to the world on shortwave radio has never been easier! The super compact ATS-606 from Sangean makes finding your favourite shortwave (and local) stations as easy as pushing a button. Let it scan through the bands for you or, with the new Auto Tuning System (ATS), it will locate and put the nine strongest signals on both the AM and FM bands into memory. You can also key in a stations frequency directly from the keypad or put up to 45 frequencies into memory for instant push-button access. It gives continuous shortwave coverage from 1.715-29.995MHz, and 13 international SW band divisions can be directly accessed at the touch of a button. There's an informative back-lit LCD screen showing frequency and time with a variety of icons to indicate the functions being accessed. You also get a dual alarm clock, sleep timer, dual time settings so you can pre-set any two time-zones, DX/local switch which allows you to set the sensitivity to suit differing conditions, and a lock switch to prevent accidentally changing stations. Comes with stereo earphones for FM stereo operation and has an antenna socket for connection of an external antenna. Requires 3 x AA batteries.

Features:

- Automatic tuning system
- 45 station memories
- Comprehensive LCD screen
- Scan tuning & direct keypad tuning
- Dual alarm clocks
- Dual time setting
- Adjustable sleep timer
- Soft carry case

Frequency ranges:

FM: 87.50-108MHz
LW: 153-513kHz
MW: 522-1710kHz
SW: 1.715-29.995MHz

Includes 13 pre-set shortwave bands
Cat D-2847

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Construction Project:

A low cost 80m DSB Transceiver - 2

In this second and concluding article describing his new easy to build PLL-synthesised 80m transceiver, the author covers its construction and adjustment.

by LEON WILLIAMS, VK2DOB

While this is not an overly complicated project, there is still a fair amount of work involved in the construction. But as long as you progress in an orderly manner and don't rush things, you will find it quite easy.

Let's start by winding all the coils. The tuned inductors are all wound on 5mm coil assemblies using 0.2mm enamelled copper wire. These comprise a base, a former, a can and a slug. Firstly glue the former into the base, being careful not to use to much glue.

When the glue has set, wind on the relevant number of turns according to the coil winding table. Take special notice of the start and finish pins, and keep the windings neat and tidy. I wind the windings with the least number of turns second, and around the bottom of the first winding.

You will probably find that soldering the wire to the pins is a little difficult at first, but this is something that only practice will cure. After the windings are in place it is a good idea to coat them with adhesive to keep them in place. I use a glue called Tarzan's Grip, which has proved to be quite suitable.

There are three inductors wound on toroid formers, type T-50-2 made by Amidon. These are quite easy to wind; it is simply a matter of passing the wire through the hole, around the outside and through the hole again until the required number of turns is achieved. After these are completed spread the winding to occupy about 80% of the circumference. L1 should be coated with glue to assist in the stability of the VCO, while L12 and L13 do not require any glue.

The remaining coils are wound on two-hole ferrite balun formers. These are used quite often in television receivers to couple the antenna, and there are two sizes currently sold. The type required is the larger of the two.

L11 is easy to wind; simply pass one end of the wire up one hole and then down the other hole and around again four times, until both ends of the wire are at the same end of the former. T3 is wound in a similar fashion, except it has two windings.

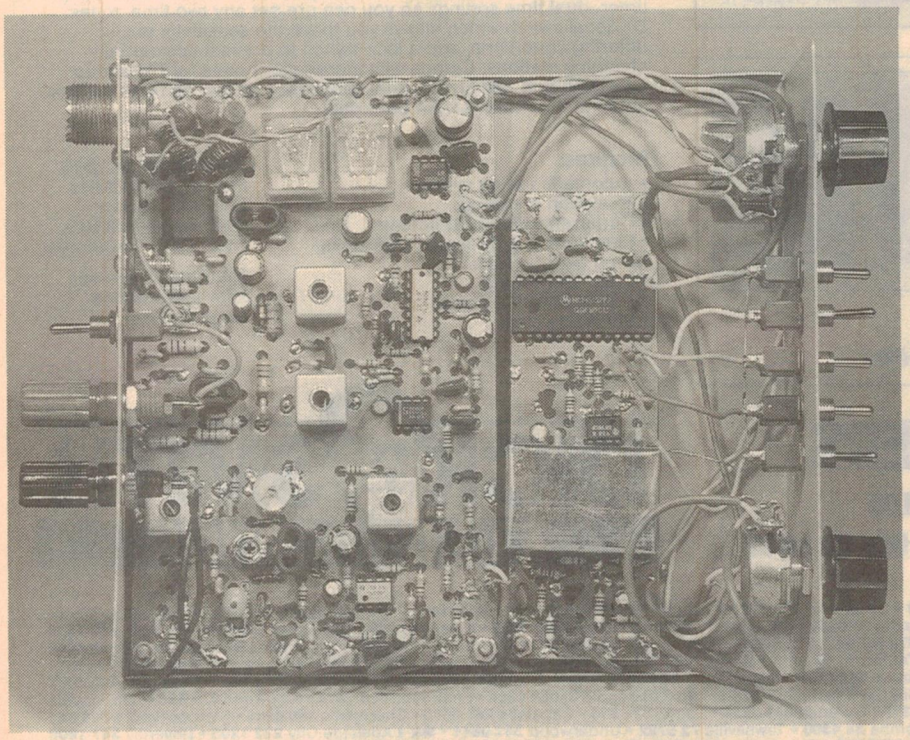
One winding will have its ends coming out of one end of the former, while the other winding's ends will appear out the other. Be careful to note which is the two-turn primary winding and which is the five-turn secondary, as it is difficult to tell after the winding is completed.

T1 requires a bit more explanation. It is wound using a *trifilar* winding. This means that three wires are twisted together and wound as if they were one. The result is tight coupling between the windings, which aids in the balancing of the balanced modulator.

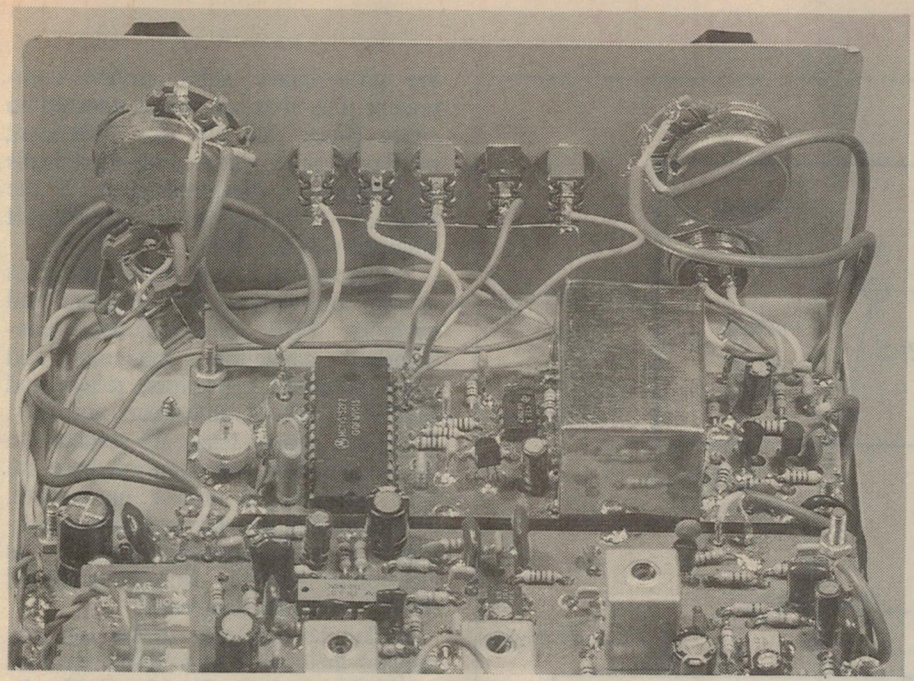
Start by taking three lengths of 0.2mm enamelled wire about 500mm long. Hold one end of the wires firm and while keeping them taut twist the other ends until there are about three twists per centimetre.

A vice and a hand drill are perfect for this job, but not essential. Wind on eight turns as discussed before and cut off the excess, leaving about 30mm protruding from the former.

Untwist the ends and scrape some enamel off the wires. Using a multimeter



A general view inside the transceiver, showing the two PC boards and the location of the various controls and connectors. The smaller PCB is used for the frequency synthesiser, while most of the remaining circuitry is on the larger board.



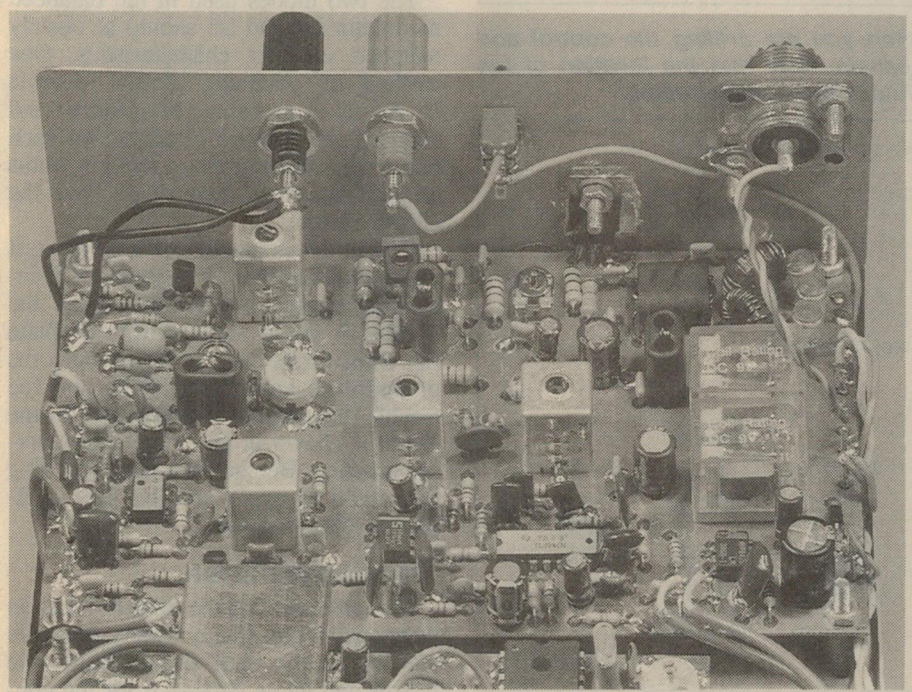
Another view inside the case, this time giving a better look at the controls on the front panel and the connections to the synthesiser board.

determine the start and finish of each winding. Twist together the finish of winding 1 (F1) and the start of winding 3 (S3) — this forms the centre tap.

T2 is wound in the same fashion except that only two wires are used, to form a *bifilar* winding. It is also important here to make sure the phasing of the windings is correct.

PC boards

If you are making your own printed circuit boards, remember that the top of the board is a ground plane. Treat the boards as if they were single sided, except keep the top side covered when etching. After etching is completed, use a large drill to clear away the copper (on



And here's a similar photo looking toward the rear panel. The IRF511 power FET (Q7) is visible at upper right, bolted to the rear panel to provide its heatsinking. Also attached to the rear panel are the DC input terminals and co-ax socket.

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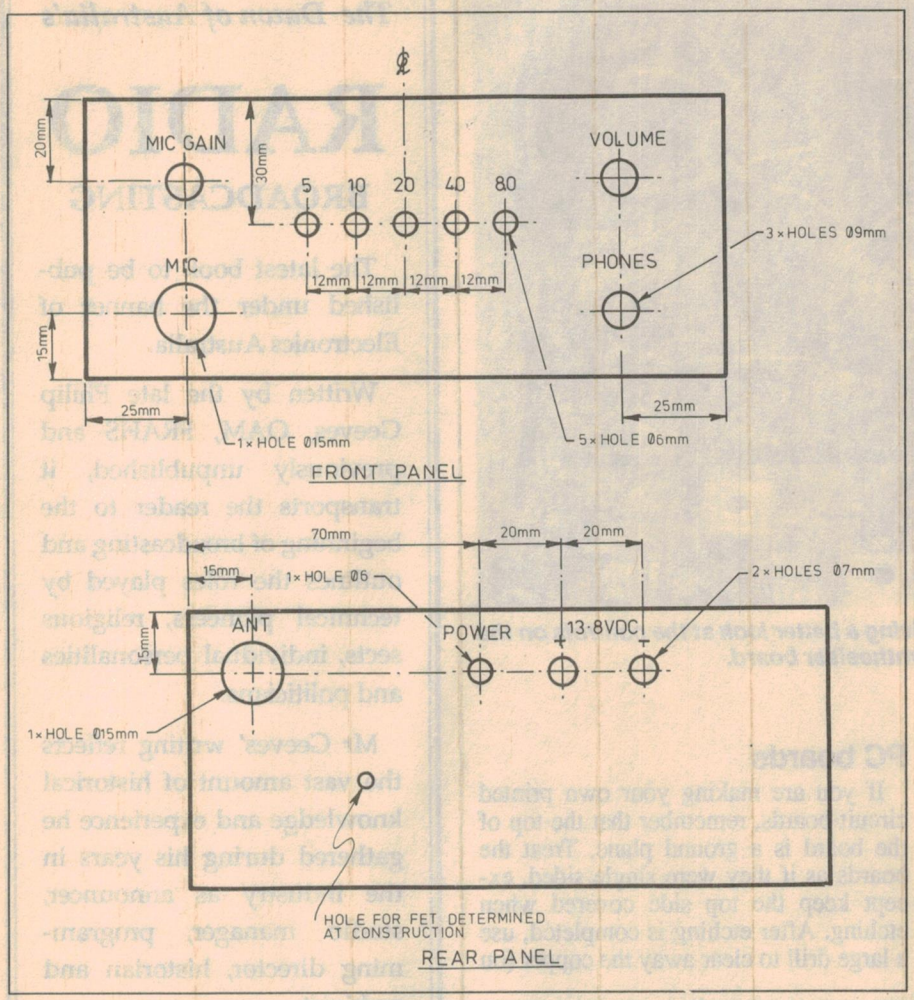
Mr Geeves' writing reflects the vast amount of historical knowledge and experience he gathered during his years in the industry as announcer, studio manager, programming director, historian and archivist.

Many of the illustrations have been provided by AWA, a firm which played a key role in building many of the first radio stations.

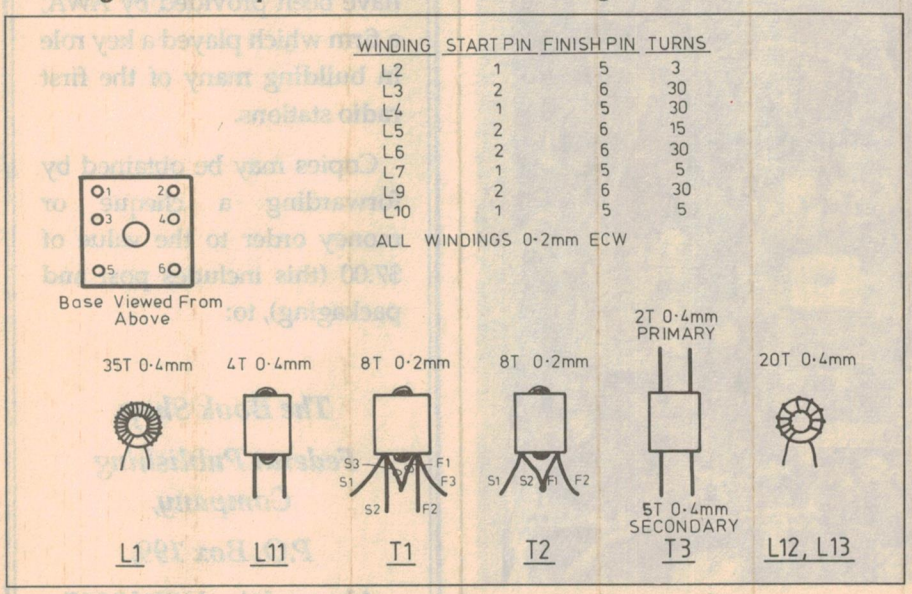
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Low cost 80m DSB Transceiver - 2



Use the above diagrams as a guide when you are drilling the control and connector holes in the front and rear panels. Note that the location of the mounting hole for the power FET is best found during construction.



Here is the winding information for the various coils and transformers used in the transceiver. Note that the three windings of transformer T1 are wound in trifilar fashion, while the two windings of T2 are wound in bifilar fashion.

the groundplane side) around component pins that are not connected to earth. Black dots on the component overlay indicate where component leads are soldered to the groundplane. These holes should be left as drilled, and not enlarged with the drill.

I suggest you mount the components in the following order: resistors and trimpots, PCB pins, diodes, non-polarised capacitors, inductors and coils, polarised capacitors, relays and finally the crystal, transistors and IC's. Some component leads are soldered to the groundplane and some of these are also soldered to tracks underneath. This is used to provide an earth connection for components such as electrolytics, which can't be soldered directly to the groundplane.

Solder the coil cans to the top side only, as this allows them to be removed easily if required. Double check the orientation of the electrolytic capacitors and IC's, as you often don't get a second chance if they are in the wrong way. Coil formers T1 and T2 are a bit unsteady, as they are only supported by the thin windings; a spot of silicone adhesive between the former and the board will hold them secure. PCB pins are used wherever an external connection is made, except for the power supply earth which is soldered directly to the groundplane.

The two diodes used in the balanced modulator D4 and D5 should be closely matched in their characteristics. One method of obtaining similar devices is to take a batch of diodes and measure the forward resistance of each one, with a multimeter set to a low ohms range. Choose the two which have the closest values.

During development of this project, it was found that there was some VCO instability caused by feedback from the RF PA. A shield was cut from tin-plate (an empty fruit can), soldered onto the groundplane around the VCO and the trouble disappeared. The position for the shield is shown in the component overlay drawing. Be careful when mounting the shield to avoid shorting any component leads to ground.

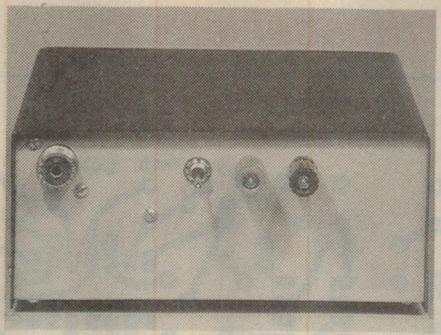
Transceiver case

The case used for the transceiver is an inexpensive type that is widely available and is just the right size to house the boards and allow clearance for the controls. The front and rear panel drilling is shown in Fig.7. It also shows the suggested labelling of controls, which was

done using rub-on lettering and then sprayed with clear lacquer.

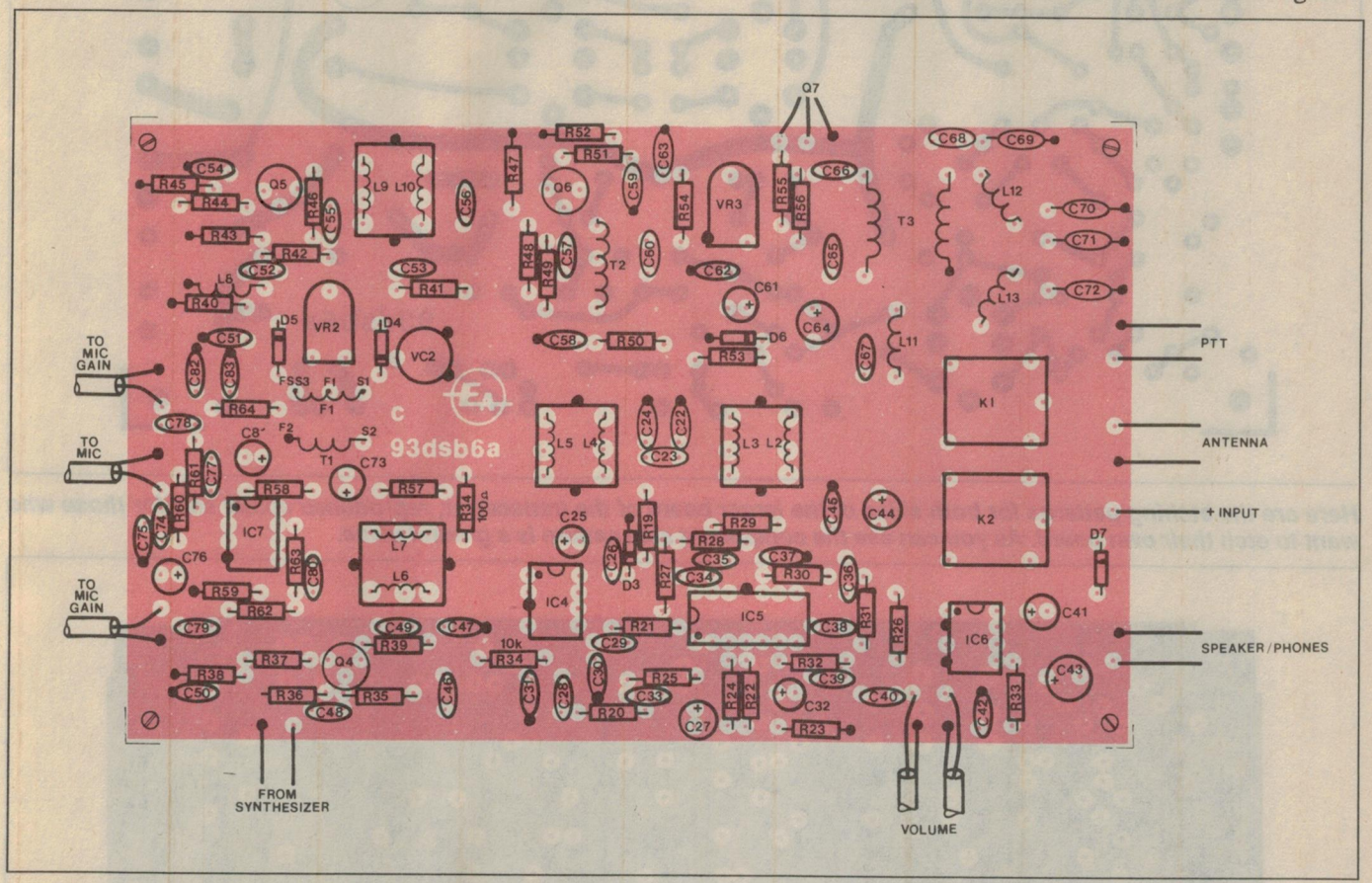
Mount the controls and sockets next. I included a power switch on the rear panel, but this may be deleted if you feel it is not necessary. The boards are mounted using 12mm brass spacers. The position of the mounting hole for the power FET is found by placing the main board on the spacers, pushing the board to the rear and then marking the position of the hole with a pencil.

Make sure that this hole is clean and free from any burrs that may puncture the insulating washer. Use a T0220 mounting kit with a dab of heatsink compound to mount the FET. Place an earth lug under one mounting screw of the antenna connector.

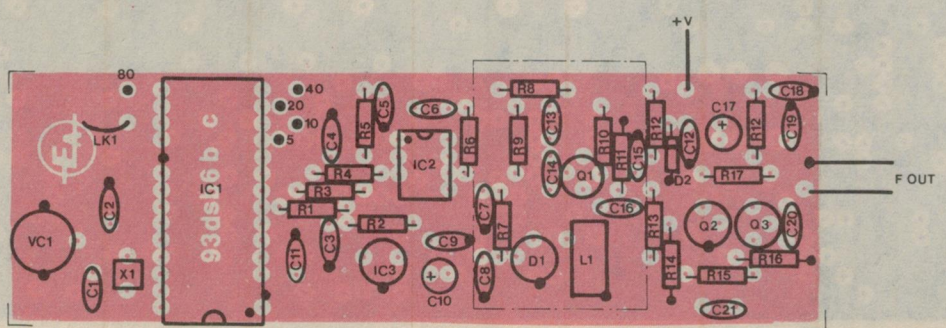


Here is the transceiver's rear end, which as you can see is not particularly exciting — but functional nonetheless.

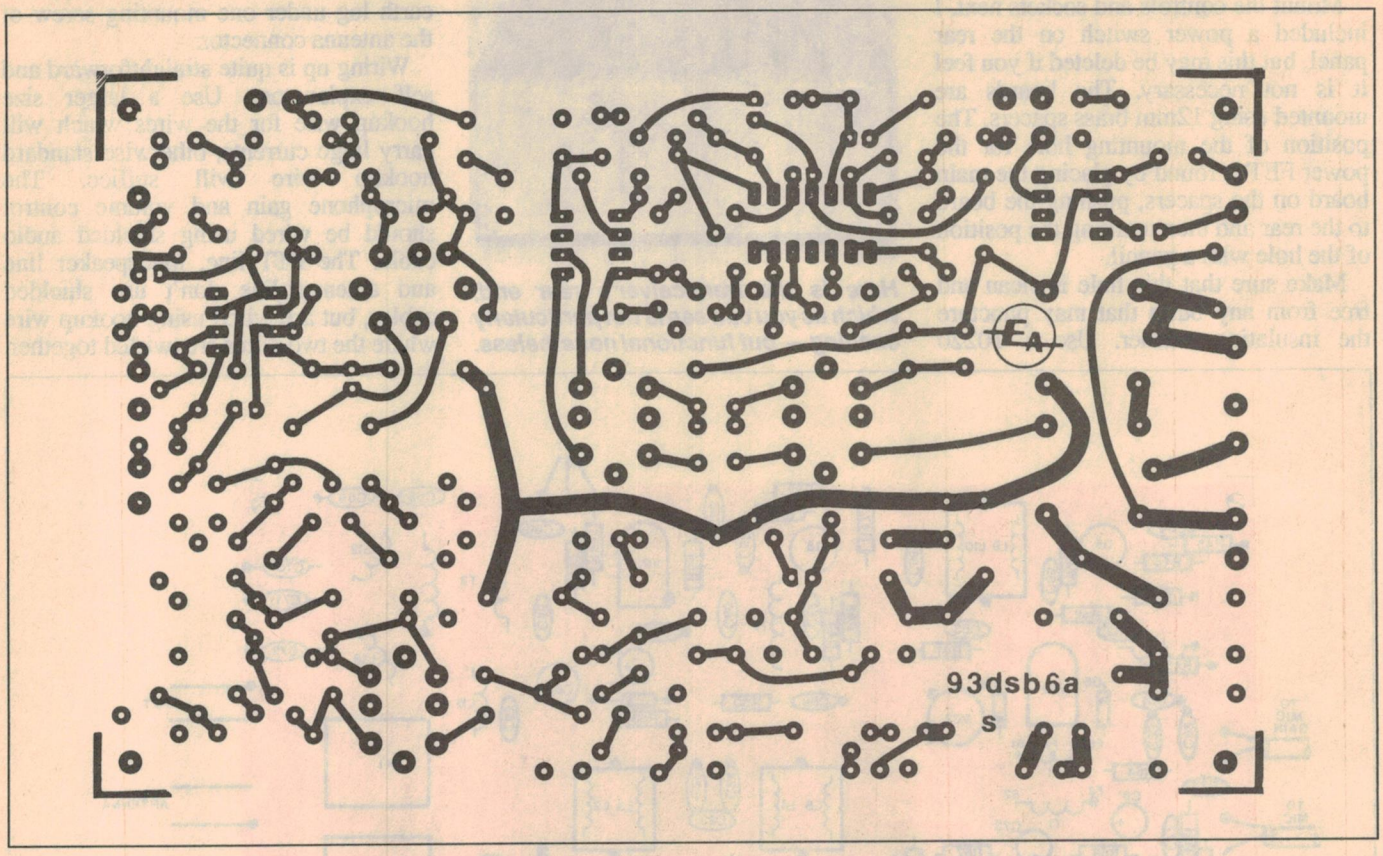
Wiring up is quite straightforward and self explanatory. Use a larger size hookup wire for the wires which will carry large currents, otherwise standard hookup wire will suffice. The microphone gain and volume control should be wired using shielded audio cable. The PTT line, loudspeaker line and antenna line don't use shielded cables, but are wired using hookup wire where the two wires are twisted together.



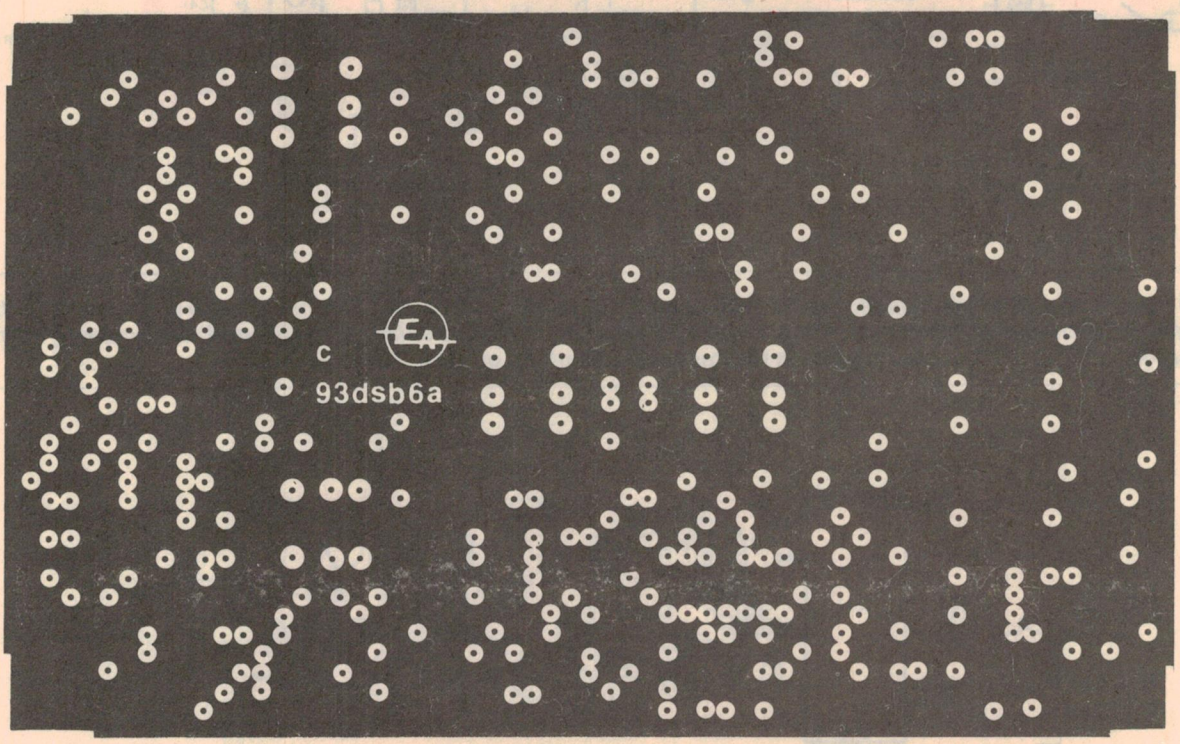
Here are the wiring and overlay diagrams for both boards of the transceiver. As mentioned in the text, both boards have a copper ground plane on the top for shielding. Some of the component leads solder to the ground plane copper, as indicated by the larger black dots. This also applies in the case of some of the off-board connections.



Low cost 80m DSB Transceiver - 2



Here are the etching patterns for both sides of the larger board of the transceiver, reproduced actual size for those who want to etch their own board. As you can see the component side pattern is a ground plane.



The photographs will give the general idea of how the wiring is laid out.

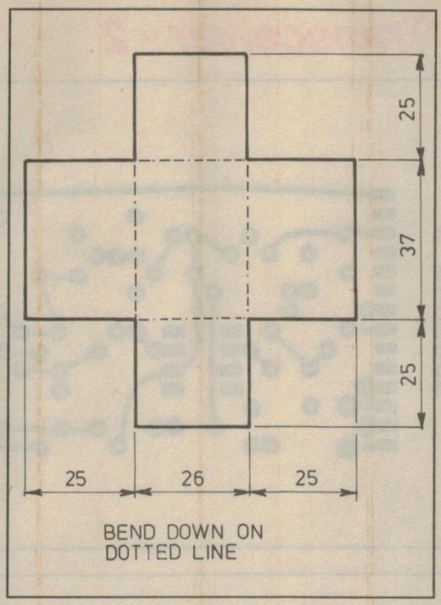
Parts for this project should be easy to find, but a few comments may be helpful. The MC145152 is available from VSI Electronics in Sydney. The toroids can be purchased from a number of sources. The IRF511 FET shouldn't be too hard to find, but if you do have trouble it is available from RS Components. A similar device, the IRF510 can be substituted if the IRF511 is unobtainable.

The NE602 was obtained from Stewart Electronic Components in Melbourne. The relays used were Dick Smith Electronics type P-8008. These have marked on them a coil voltage of 9V, but I found that they worked quite well in series with a 13.8V supply. If you use different relays they may not work in series. In this instance simply cut the PCB track between the two relay coils and connect them so that they operate in parallel.

Testing & alignment

Before we apply power, a couple of things should be done. Connect a dummy load or QRP wattmeter to the antenna socket, and plug a speaker or headphones into the phone socket. Adjust the Mic gain and Volume control to a low gain setting.

Turn the RF power amp bias control fully anti-clockwise, so that the wiper will be shorted to ground. If you have a power supply with current limiting, set it to around 200mA.



Use this diagram to guide you in making the small shield box for the synthesiser board.

Ensure the power supply is at least 13.5V DC, connect it to the binding posts and turn it on. The relays should not operate, and the current drawn should be about 80mA. A value far from this indicates a fault, and you should turn off the power immediately and start looking for problems.

If everything appears OK, turn the volume control clockwise and a hiss should be heard from the speaker. Place all the front panel switches to the 0 position and using a frequency meter, measure the frequency at the output of the frequency synthesizer.

Adjust the crystal trimmer capacitor VC1 until the meter reads precisely 3520kHz. If it reads some other frequency far from this, the loop is not locked — indicating something is wrong on the board. You will probably need a CRO to check for signals if after checking the board over again you cannot find the problem.

Assuming all is well, go through the switch combinations and check the frequency against the frequency switch setting table given in the first article.

Disconnect the dummy load and set all the switches to the 0 position except switch 80, which is set to 1. Inject a signal into the antenna socket, and adjust the frequency until a beat note is heard in the speaker.

Slowly adjust the cores in L3 and L4 for maximum output. You will probably need to lower the signal level as maximum is obtained.

Inject a frequency lower in the band, setting S1 - S5 to suit, and adjust L3 for maximum. Likewise inject a frequency

PARTS LIST

Resistors

All 1/4W 5%:

3	10 ohm (R33, 37, 44)
1	47 ohm (R18)
1	56 ohm (R40)
5	100 ohm (R34, 38, 41, 45, 64)
3	150 ohm (R7, 26, 57)
2	220 ohm (R8, 12)
2	470 ohm (R16, 19)
1	680 ohm (R9)
2	1k (R36, 43)
1	1.5k (R17)
12	4.7k (R14, 20 - 23, 31, 35, 39, 42, 46, 58*, 59)
2	6.8k (R27, 28)
9	10k (R1 - 4, 10, 29, 30, 60, 62)
4	33k (R5, 6, 11, 15)
2	47k (R24, 25)
4	120k (R13, 32, 61, 63)

All 1/2W 5%:

1	4.7 ohm (R51)
2	10 ohm (R50, 55)
1	22 ohm (R52)
1	100 ohm (R54)
2	330 ohm (R53, 56)
1	470 ohm (R47)
1	560 ohm (R48)
1	2.2k (R49)

Capacitors

1	15pF ceramic (C51)
1	18pF ceramic (C23)
1	22pF ceramic (C16)
1	82pF ceramic (C1)
2	100pF ceramic (C46, 48)
1	220pF ceramic (C2)
9	470pF ceramic (C13, 14, 22, 24, 39, 49, 55, 77, 80)
4	820pF polystyrene (C69, 70 - 72)
2	1nF ceramic (C33, 75)
1	3.3nF metallised polyester (C37)
1	6.8nF metallised polyester (C35)
6	10nF ceramic (C7, 15, 20, 21, 82, 83)
2	12nF metallised polyester (C34, 36)
2	33nF metallised polyester (C30, 31)
4	47nF metallised polyester (C38, 42, 74, 79)
32	0.1 monolithic (C3 - 6, 8, 9, 11, 12,18, 19*, 26, 28, 29, 40, 45, 47, 50,52 - 54, 56*, 57 - 60, 62, 63, 65 - 68, 78*
1	0.47uF 16V electrolytic (C81)
7	10uF 16V electrolytic (C10, 17, 25, 32, 41, 61, 76*
2	100uF 16V electrolytic (C27, 73)
1	100uF 25V electrolytic (C64)
1	470uF 16V electrolytic (C43)
1	470uF 25V electrolytic (C44)
2	40pF horizontal trim caps (VC1, 2)

Potentiometers

2	5k log pot (VR1, 4)
1	200 ohm horizontal trimpot (VR2)
1	5k horizontal trimpot (VR3)

Semiconductors

1	1N4001 diode (D7)
2	1N4148 diode (D4, 5)
2	5.1V 1W zener diodes (D3, 6)
1	8.2V 1W zener diode (D2)
1	BB212 varicap diode (D1)
1	BC558 transistor (Q1)
4	BC548 transistor (Q2 - 5)
1	BD139 transistor (Q6)
1	IRF511 power FET (Q7)
1	MC145152P2 PLL IC (IC1)
1	741 op-amp IC (IC2)
1	78L05 voltage regulator (IC3)
1	NE602 balanced mixer (IC4)
1	TL074 quad low noise op-amp (IC5)
1	LM386 AF power amp (IC6)
1	TL072 dual low noise op-amp (IC7)

Inductors

3	T-50-2 toroids (L1, 12, 13)
4	5mm coil former assemblies with core (L2/3, L4/5, L6/7*, L9/10)
1	47uH RF choke (L8)
4	Two-hole ferrite balun former (large) (T1 - 3, L11)

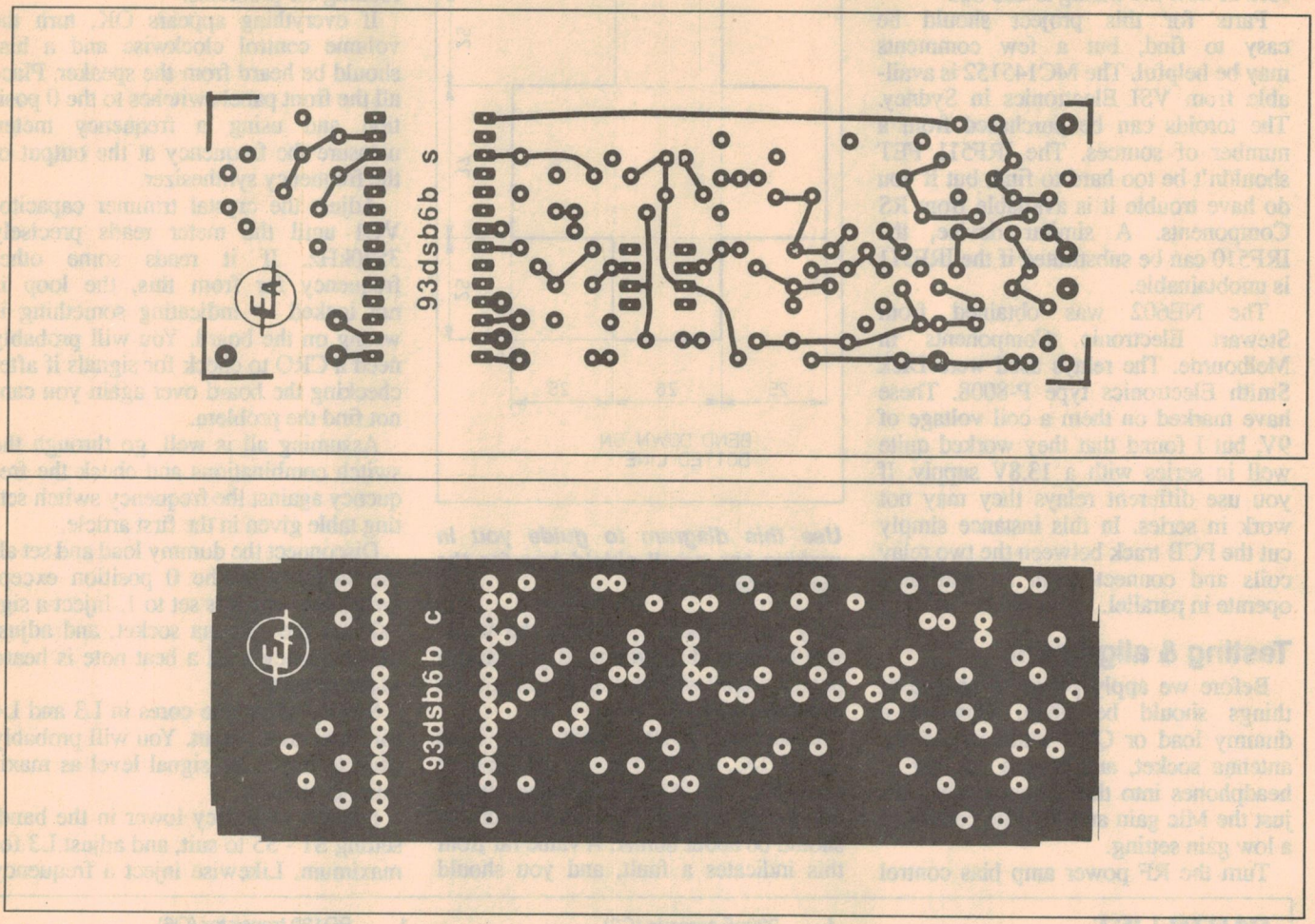
Miscellaneous

1	PC board code 93dsb6a, 153mm x 94mm
1	PC board code 93dsb6b, 122mm x 38mm
1	Metal case, 184 x 70 x 160mm
1	SO239 co-axial socket
2	Binding posts, 1 red and 1 black
1	Microphone socket
1	6.5mm stereo phone socket
6	SPDT miniature toggle switches
2	SPDT PCB-mount relays
1	10.240MHz crystal

Two knobs; 1 x TO-220 insulating washer kit; six 12mm brass spacers; 3mm screws and nuts; heavy and light hookup wire; shielded audio cable; 0.2mm and 0.4mm enamelled copper wire; earth lug; tinplate for shield; PCB pins, etc.

*See text

Low cost 80m DSB Transceiver - 2



The corresponding PCB patterns for the transceiver's smaller board are shown here, again actual size. As before the component side copper forms a shielding ground plane.

higher in the band (with S1 - S5 set accordingly), and adjust L4 for maximum. The object is to obtain a flat response across the band of interest. That's all there is to adjusting the receiver!

Reconnect the dummy load to the antenna socket. Ensure that the Mic gain control is at minimum, and adjust the balanced modulator trimpot VR2 to halfway. Now place a short across the PTT line. The relays should operate, and more than likely there will be some power indication on the power meter.

While watching the current meter, slowly turn the PA bias trimpot VR3 clockwise until the current has risen to around 300mA. Adjust VR2 and VC2 for minimum power output. You should be able to get it much lower than 1mW. The controls interact, so you will need to do it several times. If you don't have a QRP power meter, a CRO can be placed across the dummy load. If you have neither of the above instruments then use a receiver to detect the null in signal level.

Once the modulator is balanced, turn the bias trimpot fully anticlockwise and noting the current drawn, readjust the trimpot in the clockwise direction so that the current is now 200mA higher. This should be about 380mA.

Connect an audio oscillator to the microphone socket and set it for 50mV at 1kHz. Turn the Mic control clockwise, and watch the current and the power output meter. The rise should be smooth; any bumps indicate some instability and should be looked into.

Adjust L6 and L9 for maximum output. As for the receiver these two coils should adjusted to give a flat response across the band. If you have a peak reading wattmeter or use a CRO, you should be able to obtain at least 6W PEP output.

I did try a couple of IRF511's to see if there was any variation in power out between different devices. One device gave an output of nearly 8W PEP, but more importantly a different setting was required for the bias trimpot. I mention this because even though the above setup procedure should be suitable, it may be necessary to experiment with the bias setting for best results.

The transmitter does not have an ALC (automatic level control) circuit, so it is up to the operator to make sure that the transmitter is not over driven. Over driving will cause unwanted distortion products.

This adjustment is best done by connecting a CRO across the dummy load and speaking into the microphone while observing the transmitted waveform. Advance the Mic gain control until the waveform just starts to compress, and then back it off slightly. Mark this position and use it when on air. If you do not have access to a CRO, have someone listen to your signal and advance the Mic gain control until the other station hears distortion; then back it off slightly and note the position.

Your new transceiver should now be ready to go. See how many contacts you can have far and wide, and don't forget to tell them you built it yourself! ❖

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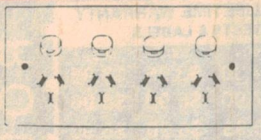
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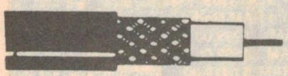


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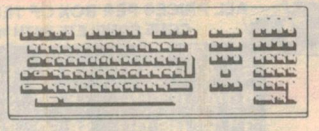
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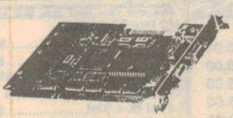
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Stand alone 3pin plug
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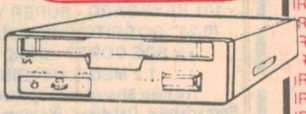
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Data capacity.....540 MBytes
Data transfer Rate
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Comes with a "Grassroots" SCSI host adaptor card, for 286 or 386 machines.
Has an on board BIOS, so no drivers are required. Will BOOT MS-DOS using either 21MB,or 1.44MB or 720KB diskettes. DOS compatible with MS-DOS 3.3, 4.01 & 5.00 (We are testing DOS 6.0 at the moment)
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QFMT program is used in lieu of MS-DOS format program. The unit can BOOT the system as drive "A:" or "B:" in either 720K, 1.44MB, or 21MB format. Cluster size can be adjusted (2, 4, or 8 sector-per-clusters instead of the DOS standard 16.) The FAT can also be made larger (16-bit instead of DOS's 12-bit FAT) Optical tracking system. Magnetic storage media.

C11850.....WAS $849.00. NOW ONLY $649.00 (with Grassroots Adaptor)
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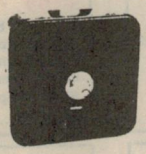
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ROD IRVING ELECTRONICS

BUILD YOUR OWN CLOCK!

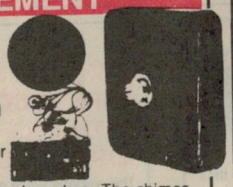
Imagine having a clock on your wall that is totally individual. Something that nobody else has. A clock that says something about its owner.
Where do you buy a clock like that. You don't buy one, you make it. We'll supply all the working parts but you have to supply the imagination.

ANALOGUE QUARTZ CLOCK MOVEMENTS



Make your own clock using these analogue movements which are simple to use, offer quartz crystal accuracy and require a single AA size battery to operate.
The CMOS circuit drives a self starting, two pole stepper motor from a cystal iscillator, and reduction drive from the second hand to the minute and hours hands is through nylon gears.
A standard basic quartz clock movement as described above. The movement is supplied without hands but uses the seperate hands shown below. Time is set with a knob on the back. Movement is attached to face with a threaded brass boss having a shouldered brass collar nut. A10074....**$12.95**

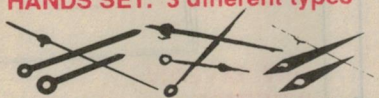
CHIMING CLOCK MOVEMENT



A quartz crystal clock exactly as standard movement, as above, but having in addition a combined microchip chimes generator and amplifier pcb, driving a 57mm diameter moving coil loudspeaker. The chimes generator and amplifier module is powered separatley by an additional two AA cells, and two control wires from the clock module cause tunes to be produced hourly. The microchip follows this sequence every hour and usually needs to be 'synchronized' to the actual time with the aid of the manual sequencing click switch provided, which simulates the closing of the clock's signal contacts. The whole assembly can be mounted in a custom clock case.

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*1 to 1.5 input Voltage, *Min. imput pulse <100µs *2µA standby *32.768KHz *Max imput Frequency 7Hz
Overall Size: 68 x 35 x 24 mm
A plastic bezel is available for use with this module, size 68 x 35 mm and increases the overall depth of the module to 27mm. The module requires a 1.5V AA cell (not supplied).

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Designed for craftsmen and professionals requiring micro-precision soldering with adjustable power equivalent to 60 watts.Butane gas power lets you solder those hard-to-get-to jobs with cordless freedom. The Portasol has over 40 engineered component parts for safety, precision, and power. It liminates all risk of leakage current to sensitive circuits allows anti-static soldering.
The Portasol can be used continually for up to 90 minutes after a single refill of butane gas.
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- CONSTANT SPEED INTERFACE

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- 2400 BPS (V.22 bis)
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- BELL 212A (1200) & BELL 103 (300)
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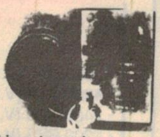
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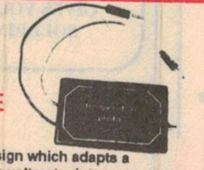
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If your looking for an ear catching alarm that produces a melodic 2 tone sound that packs quite a punchfor its size, then this is the module for you. It is designedfor those times you need an "easy on the ears" sound. It's a great alarm for things such as a water level monitor,or automotive gauge monitor. This module uses eay to get parts and can be built in a couple of hours.
Sil Chip Jan 1991.

K10095.......................................$9.95



LOW COST TEMPERATURE PROBE

An easy to build probe design which adapts a multimeter or an electronic voltmeter into a general purpose thermometer. It uses easy to get components and is also suitable for building into other projects where they require temperaturesensing.It's ideal for measuring heatsink temperatures, how hot it gets inside your car
or even checking the temperature in the wine cellar.

K10215.............................$19.95



UNIVERSAL POWER SUPPLY
Low Cost Circuit give +15V, -15V or ±15V

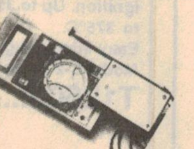
This small board enables you to obtain +15V, -15V or ±15V DC from a number of different transformer and rectifier combinations. It's one PCB pattern you can use in four different ways to obtain 15V.
Silicon Chip Aug 1988

K10125...................................$12.95

KNIGHTRIDER LED SCANNER

This little kit is a lot of fun.
If you have ever seen the television show "Knightrider" you will probably remember the front of the computerised car which has a row of red lights moving back and forth supposedly scanning the area. Well now you can simply make a row of 20 light emmiting diodes which scan back and forth. Place it on the kids bike or skateboard
or on the front of a radio controlled car.
It uses cheap and readily available ICs, a 555 timer and a 4017 decade counter.
You could even use it as visual deterrent to thieves by placing it on a burglar alram. Sil Chip Nov '88

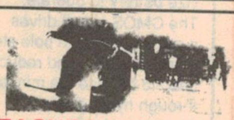
K10135.......................................$17.95



TEMPERATURE ADAPTOR FOR YOUR MULTIMETER

A simple add-on project which extends the functions of your multimeter to the measurment of temperature. It is particularly suited to digital multimeters. It can be used to measure temperature over the range from -55°C to +150°C with an accuracy of 0.5°C or better.
(ETI 153 ETI June 1983)

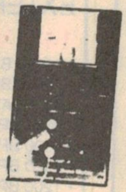
K10300.......................................$24.95



THE SCREACHER CAR BURGLAR ALARM

A low cost car alarm designed with a new deterrent strategy.
Instead of using the alarm to try to draw attention of passers-by to the felony in progess this alarm sounds inside the car, to deafen the thief and make it too uncomfortable to proceed
with stealing the car!
(EA AUG 1986)

K10145.......................................$36.95



TEST METER MEASURES RESISTANCE FROM 100 OHMS DOWN TO 0.005 OHMS.

This little device allows you to measure a low-value resistance that ordinarily could'nt be measured with a standard multimeter
(ETI 158) ETI Nov 1981

K10295.......................................$29.95



BUILD THIS SNEAKY ANTI-THEFT DEVICE "CAR IGNITION KILLER"

This great little kit is designed to frustrate any car theif into leaving the car and running off. Most of todays burglar alarms are fine except that they are easily circumvented.
This kit can be simply fitted to the car and is cheap and effective.
After the thief has started the car the "Car Ignition Killer" literally makes the engine die in a matter of seconds. (EA 84 AUI FEB 84)

K10310.......................................$22.95



CONTROL YOUR TAPE RECORDER WITH THIS VOICE -OPERATED RELAY

This versitle voice operated relay (or VOX) can be used to control a tape recorder or a transmitter or even a slide projector. It can be used with a high or low impedance microphone, or a high level sorce such as a tape recorder. It avoids the need to use the press to talk switch on the microphone everytime you wish to speak. By using this kit the tape recorder will activate only when there is something to be recorded and will not leave long gaps between recorded segments.

K10305...................................$19.95



VIDEO RF MODULATOR

This modulator has many applications in such things as video games, TV pattern generators, etc. It features a very stable oscillator and low modulation distortion.
It's great for modulating a computer's video output onto a suitable "RF" carrier produced by an oscillator operating on an unused TV channel frequency. Giving you a cheap visual display unit.
(ETI 760) ETI October 1981

K10320.......................................$17.95



HEADPHONE AMPLIFIER

If you play any electrical musical instrument then this is the kit for you!
Practice for hours without upsetting others or use it to monitor your own instrument in the midst of a noisy jam session. It's an economical way for low budget bands to derive more pleasure from thier sessions.

K10315 EA Feb 1984.........$34.95



15W. 12 - 240V INVERTER

This 15W inverter is ideal for operating low power AC equipment from a 12V battery. It's based on the popular 40W inverter and is ideal for use with camcorder battery recharges and telescopes drive.
(S.C. JUNE 92)

K10375.......................................$49.95



1GHz FREQUENCY COUNTER

Did you look at our latest 50MHz frequency counter design longingly (because of its low cost), but finally decide against it - because you either need more resolution and/or operation at higher frequencies?
Well, here's its 'big brother' of that design, offering seven digits of resolution and operation up to 1GHz. Despite this higher performance the emphasis is still on good value for money though - infact there probably isn't a cheaper way to get yourself a 1GHz frequency counter.
(E.A. APRIL 93)

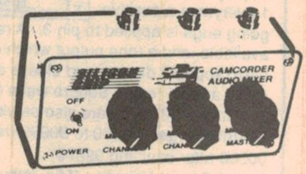
K10380.......................................$165.00



RS232 FOR COMMODORE 64 INTERFACE

A simple project to give your Commodore RS232 compatibility with other hardware.
(ETI 1606 JULY 86)

K10330.......................................$24.95



CAM CORDER MIXER KIT

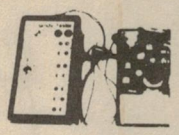
Jazz up your home video's by mixing in some background music from either CD or tape. This simple 2-channel mixer runs off a 9 Volt battery, uses only one cemmen IC & can be built in a couple of hours.
(S.C. MARCH 93)

K10340.......................................$29.95

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TRANSISTOR TESTER

Have you ever desoldered a suspect transistor only to find that it checks OK? trouble shooting exercises are often hindered by this type of false alarm, but many of them could beavoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. '83) 83TT8

K10080.....$22.95

PLAYMASTER 300W AMPLIFIER

This module will deliver up to 200 watts into an 8ohm load. Comprehensive protection is included and a printed circuit board brings it all together in a rugged easy-to-build module. It can be built in either fully-complementary or quasi-complementary versions, so output transistor shortages should be no problem at all. (80pa6) (EA July '80)

K10085.....$109.00



SOLAR GENERATOR

The ETI-569 Solar charger is designed to charge any standard 12 V lead acid car battery in any area where mains power is unavailable. It is ideal for remote data acquisition stations, caravans and boats.
Of course there are other solar chargers around, but these are extremely expensive. With the ETI-569 the emphasis is on simplicity and cheapness.

K10005.....$13.95



BALANCED INPUT DIFFERENTIAL PREAMP

This versitile little preamp has a host of applications in the audio-and-beyond range, not the least of which would be as a balanced mic preamp.
(ETI 461 Dec'82 ETI)

K10070.....$19.95



50W AMPLIFIER MODULE (ETI 480)

Use these high performing modules in band amps, P.A even HiFi's.
Very simple to build and work because everything's on the one pcb.
Heatsink optional extra

K10040.....$27.95

100 W AMPLIFER MODULE (ETI 480)

Similar to the above module but this one is 100 watts of power.
Heatsink optional extra

K10045.....$32.95



ELECTRIC FENCE KIT

Main to battery powered, this electric fence controller is both inexpensive and versitile. Based on an automotive ignition coil, it sould prove an adequate deterrent to all manner of livestock. Additionally it's operation conforms to the relevant clauses of Australian Standard 3129. (EA Sept. '82) 82ef9

K10110.....$23.95

GENERAL PURPOSE PREAMPLIFIER

A general purpose stereo preamplifier using a single LM382 IC which can be tailored for use with magnetic pickups, tape recorders, and microphones by changing a few components
(ETI445) (ETI July '76)

K10055.....$14.95

MIKE PRE AMP

High quality transformers for matching balanced microphones into unbalanced inputs are quite expensive. This simple preamplifier will accept balance inputs directly.
(ETI May '77, ETI 449)

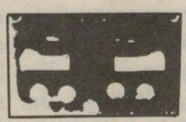
K10060.....$14.95



ELECTRIC FENCE CONTROLLER

Restore the discipline to the farm or allotment with this new electric fence controller. It features higher output power and lower current drain than the previous design.
(EA Dec. '85, 85ef11)

K10115.....$61.95

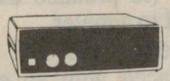


GENERAL PURPOSE AMPLIFIER CLASS B.

One of the handiest "tools" for the electronics experimenter is a genuine purpose audio amp. This module will work from a wide range of supply voltages, has very good sensitivity, is robust, reliable and easy to build too!
(ETI 453) ETI April '80)

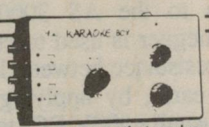
K10065.....$14.95

DISCOLITE



This kit makes your lights do amazing things. With 4 light channels controlled by 4 separate audio channels. Eg. Forward, reverse, auto reversing chaser patterns, alternating light patterns, adjustable rate for light patterns, simultaneous strobe on all four channels. Plus many more features! (Sil Chip July 1988)

K10130.....$155.00



KARAOKE BOX

It's time to bring out those hidden talents that you've always known were there. With this project you can remove the lead vocal from almost any recording and replace it with your own via a standard microphone. It's a great way to live up a party.
E.A. November '91.

K10345.....$27.95

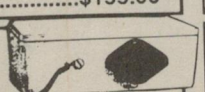
RGBI to PAL ENCODER/ MODULATOR



Here's the design for a low cost RGBI to PAL video encoder and RF modulator, suitable for use with an IBM or compatible computer fitted with a colour graphics adaptor (CGA). By providing a modulated RF signal on a suitable television channel, it allows a standard colour T.V receiver to be used as a colour monitor for games etc. E.A August '89.

K10335.....$49.95

HIGH ENERGY IGNITION SYSTEM



Is your car still limping along with outdated Kettering ignition? What? You're still cleaning points, adjusting dwell, checking timer and all that automotive drudgery? Now you can fit this High Energy Ignition System and forget those tune-up hassles.
S.C. May '88.

K10355.....$55.00

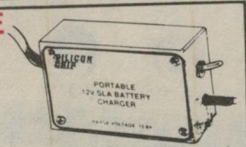
NICAD BATTERY DISCHARGER



Are you having battery problems with your video camera or mobile phone? This low cost device will solve your problems. It will correctly discharge a nicad battery so it can be recharged to full capacity. E.A October '92.

K10365.....$27.95

PORTABLE 12V SLA BATTERY CHARGER



This simple project allows you to recharge 12V sealed lead batteries from your car. It uses only one low-cost IC and charges at a constant 13.8V.
S.C. July '92

K10370.....$24.95

TOUCH LAMP DIMMER



Are you still persevering with one of those old knob type dimmers? You are! Well get into this Touch Lamp Duimmer. You can turn your lights on and off or dim them just by touching the decorative plate.
S.C. June.

K10185.....$33.95

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Construction Project:

An Insulation Resistance Tester

Don't spend several hundred dollars on an insulation resistance tester (or megger as some people call them) — build this one. It has a genuine 500V DC output across a 1M ohm load, which means it can test to AS 3000 specifications. It also has a low ohms facility, and costs a fraction of a commercial model.

by PETER PHILLIPS

Before we start, let's clear up what we are going to call this project. Is it a Megger or an insulation resistance tester? In fact, they're the same thing, except 'Megger' is strictly a brand name. Most people call an insulation resistance tester a megger, in the same way we call a ballpoint pen a biro. So because megger is easier to say (and write) we'll stay with the trend.

Having said that, now let's clear up what a megger is, as electronics technicians will probably have different opinions to an electrical contractor.

The main use of a megger is to test a power wiring installation to check that it conforms to the AS 3000 standards. Here, a megger is used to check the insulation resistance between live conductors and earth, by applying a DC test voltage (usually 500V DC) to the circuit. Any leakage current that flows in the circuit as a result of the test voltage is indicated by deflection of a meter pointer. The meter is calibrated in ohms rather than current, as this is a more useful indication.

There are other uses for such a device, such as measuring the leakage resistance of a motor, capacitor, heating element and other mains operated equipment. In fact, most electricians involved in wiring installation and appliance repair own a megger. In electronics, a megger can be used to measure the leakage resistance of capacitors, transformers, appliances and so on.

But these days, there's another feature found on most meggers — the ability to measure a *low* resistance. The Australian wiring standards specify the maximum allowable resistance of the earthing conductor in a wiring installation, so it makes sense to include a low resistance testing facility on an instrument used to measure insulation resistance. After all, both tests should be carried out before the installation is connected to the mains.

CAUTION

This project can produce hazardous voltages of up to 900V. Take extreme care during its construction and use.

Before solid-state electronics came along, meggers were a rather mechanical affair, involving a hand-operated DC generator (to produce the test voltage) connected to a meter.

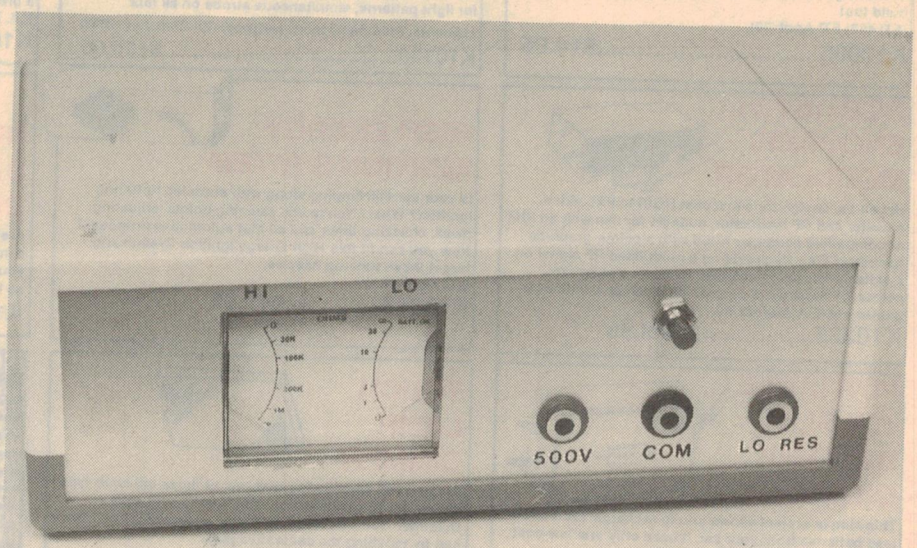
These days, the DC generator has been replaced with an electronic converter, powered by batteries. And you'd think designing such a device would be relatively easy. Not so, as we'll explain...

Meeting AS 3000

Over the years, there have been a number of insulation resistance tester designs presented in magazines, with varying success. To explain the problems, first we need to look at the AS 3000 requirements. For those who aren't sure, AS 3000 covers those rules pertinent to fixed electrical wiring.

Developed by the Australian Standards, the rules are presented in a publication (AS 3000 Wiring Rules) that's updated every so often. The latest edition is 1991, although the rules I'm going to refer to here haven't changed since the last edition.

Here's a summary of what AS 3000 has to say about testing an electrical installation. For those with the manual, it's AS 3000 Rule 1.5:

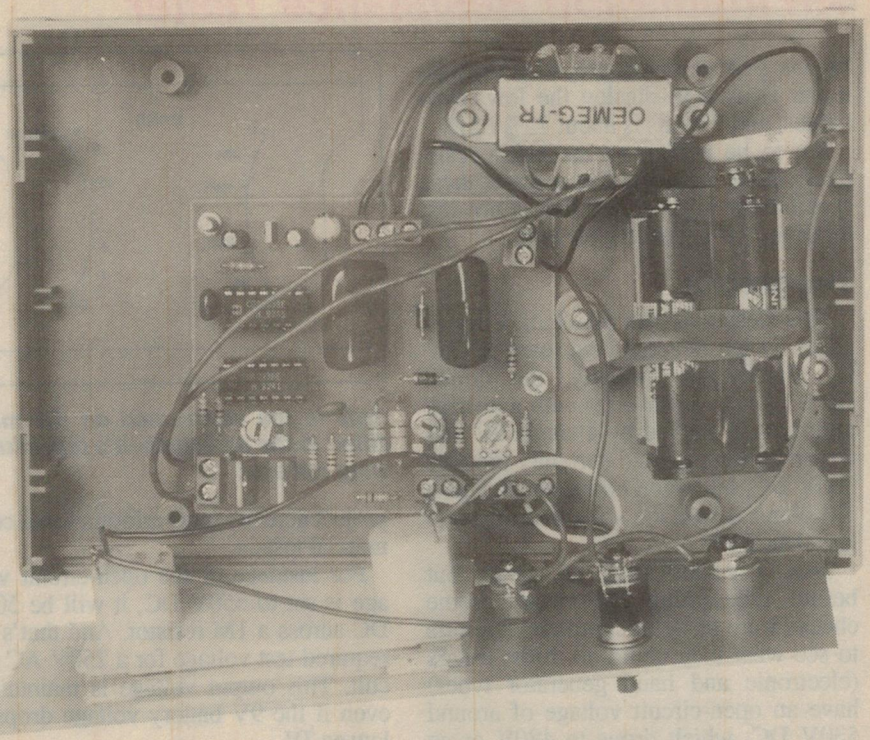


Clause 1.5.1 says *Electrical installations shall be tested and checked before being placed in service and after modification to verify proper execution of the work in accordance with this Standard. Compliance with this Standard requires a number of tests, including the tests specified in Clauses 1.5.2 and 1.5.3.*

Clause 1.5.2 is about insulation resistance, and has a number of sub-clauses. However, the important one is 1.5.2.1, which (after Plain Englishing and rearranging) says: *The insulation resistance between a live conductor (or live part) and earth is to be measured by applying a direct current at a voltage of 500V (for a circuit where the working voltage doesn't exceed 250V). For other cases the DC test voltage is 1000V.*

Clause 1.5.2.2 says: *The insulation resistance between all live conductors connected together and earth, either of the complete installation or of any part thereof, measured with all fuse elements in place and all switches on shall be not less than 1 megohm.*

So there's the important values: 500V DC and 1M ohm. In other words — and this is the difficult bit — the megger should deliver close to 500V if the resistance of the circuit being tested is 1M ohm. That is, we need an output power of 250mW. As well, the meter scale should have the 1M ohm graduation in an uncrowded part of the scale. Now let's go on...



This shot shows how everything fits inside the case. The battery pack is held in place with a large rubber band, held to the case with cable clamps.

Clause 1.5.2.4 is about heating elements which, when new, often have a fairly low resistance between the element and the case. AS 3000 allows this to be as low as 10k ohms.

There's more to all this, and the rules go on at length about what to do if there's electronic devices connected as a part of the fixed installation and so on. They also state that: *The insulation resistance between all live conductors enclosed in a busway and earth shall not be less than 0.2M ohm.*

Therefore, for a megger to be useful for AS 3000 testing, the meter scale has to have clearly visible markings for 1M, 200k and 10k ohms. Previous designs often boasted an ability to measure resistance values of 100M ohm, but paid little attention to measuring values specified by AS 3000.

The next test in Section 1.5 is the resistance of the earthing run. The important rule here is clause 1.5.3.3, which is for the MEN (main earth neutral) earthing system. It says:

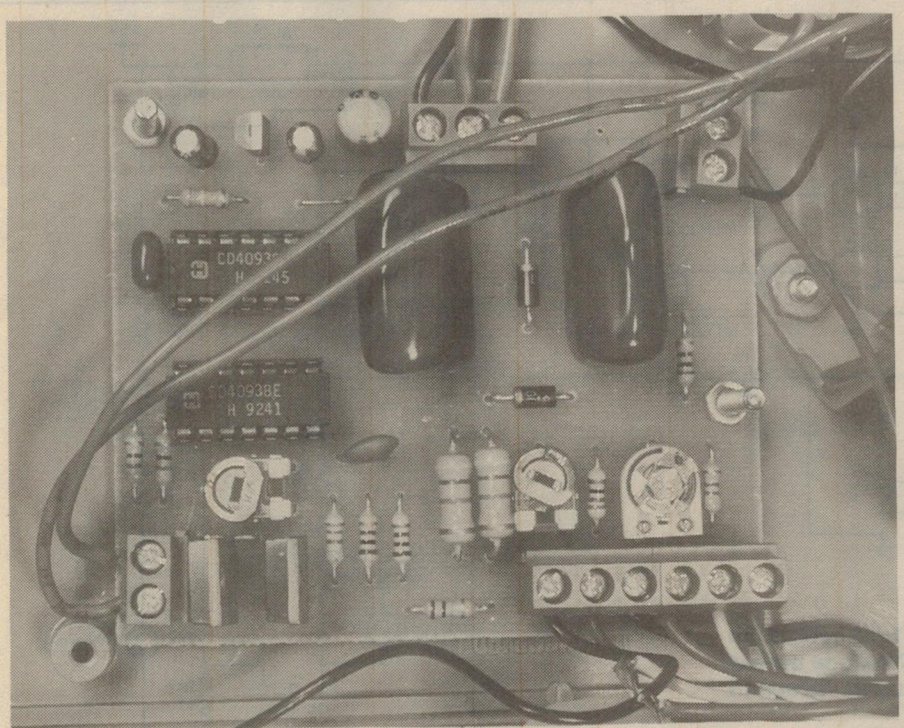
(a) The resistance from any point on the installation required to be earthed to the point where the main earthing conductor is connected to the neutral conductor shall be:

(i) low enough to permit the passage of current necessary to operate the circuit protective device; or

(ii) 2 ohms, which ever is the lesser.

(b) The resistance from the earthing electrode to the point where the main earthing conductor is connected to the neutral conductor of the supply system shall not exceed 2 ohms.

So the next important resistance figure



Here's a close up of the PCB in the prototype. You might want to refer to this when assembling the board.

An Insulation Resistance Tester

here is 2 ohms. In our project, a separate meter is used to display the low ohms values, and 2 ohms is about 75% FSD.

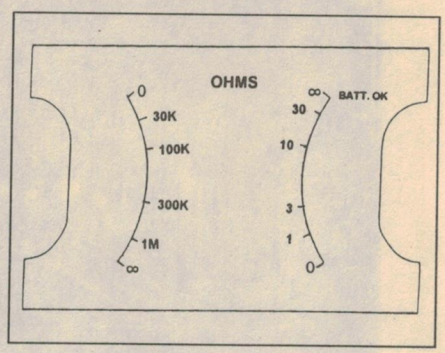
So, to be useful, an insulation resistance tester must be able to meet these specifications. Anything less is not just inferior — it's virtually useless.

The project

This design is the result of a lot of effort by the development team at Oatley Electronics. Initially, the circuit started out as an inverter with a voltage multiplier. Powered by a single 9V battery, this design could certainly produce 500V DC, but when connected across a 1M ohm resistor, the voltage dropped to less than 200V.

This was obviously no good, but before redesigning the circuit, some checks were made of commercial testers to see what they could do. Most testers (electronic and hand generator types) have an open-circuit voltage of around 530V DC, which drops to 480V or so across a 1M resistor. When loaded with a 10k resistor, the output voltage in all cases is quite low — less than 100V DC.

Using these figures as a guide to performance, the team started again and the result is this project. An important part of the design criteria was cost, and although the parts cost less than $25, this



This is the scale used on the meter fitted to the prototype. It's reproduced here full size.

project actually out-performs some commercial testers.

For instance, if the open-circuit voltage is set to 550V DC, it will be 500V DC across a 1M resistor. And that's the required test voltage for a 250V AC circuit. This output voltage is maintained even if the 9V battery voltage drops as low as 7V.

The low resistance measuring section operates by pumping up to 25mA DC into the circuit under test. This value of current will sort out bad connections far better than a typical ohmmeter, as the usual test current is not high enough to 'wet' the connections. This facility is ideal for checking the winding resistance of a 240V motor, and other low resistances.

As you can see from the lead picture, the tester has two meters, one for the high resistance and another for the low resistance. The meter movement is actually a VU meter from a stereo tape recorder, and is ideal here as it's compact and cheap. The only thing you need to do is fit a scale over the existing VU scale.

Now let's look at the circuit...

The circuit

The circuit is basically a DC-DC converter, where the logic gates form an oscillator that drives MOSFETs Q1 and Q2. The AC output of transformer T1 is rectified and stepped up by a voltage doubler, using diodes D1 and D2. The converter is regulated to maintain the DC output voltage under loaded conditions or if the battery voltage falls.

Gate IC1d, R1 and C1 form an oscillator that relies on the Schmitt action of the gate to operate. The frequency of this oscillator is about 300Hz.

The oscillator output is applied via the three cascaded gates IC1c, IC1b and IC2c to MOSFET Q2. The overall inverting action of these three gates means that Q2 is switched on when the oscillator output is low (0). The output from the oscillator is also applied via two cascaded gates IC1a and IC2d to MOSFET Q1. The dual inverting action of these

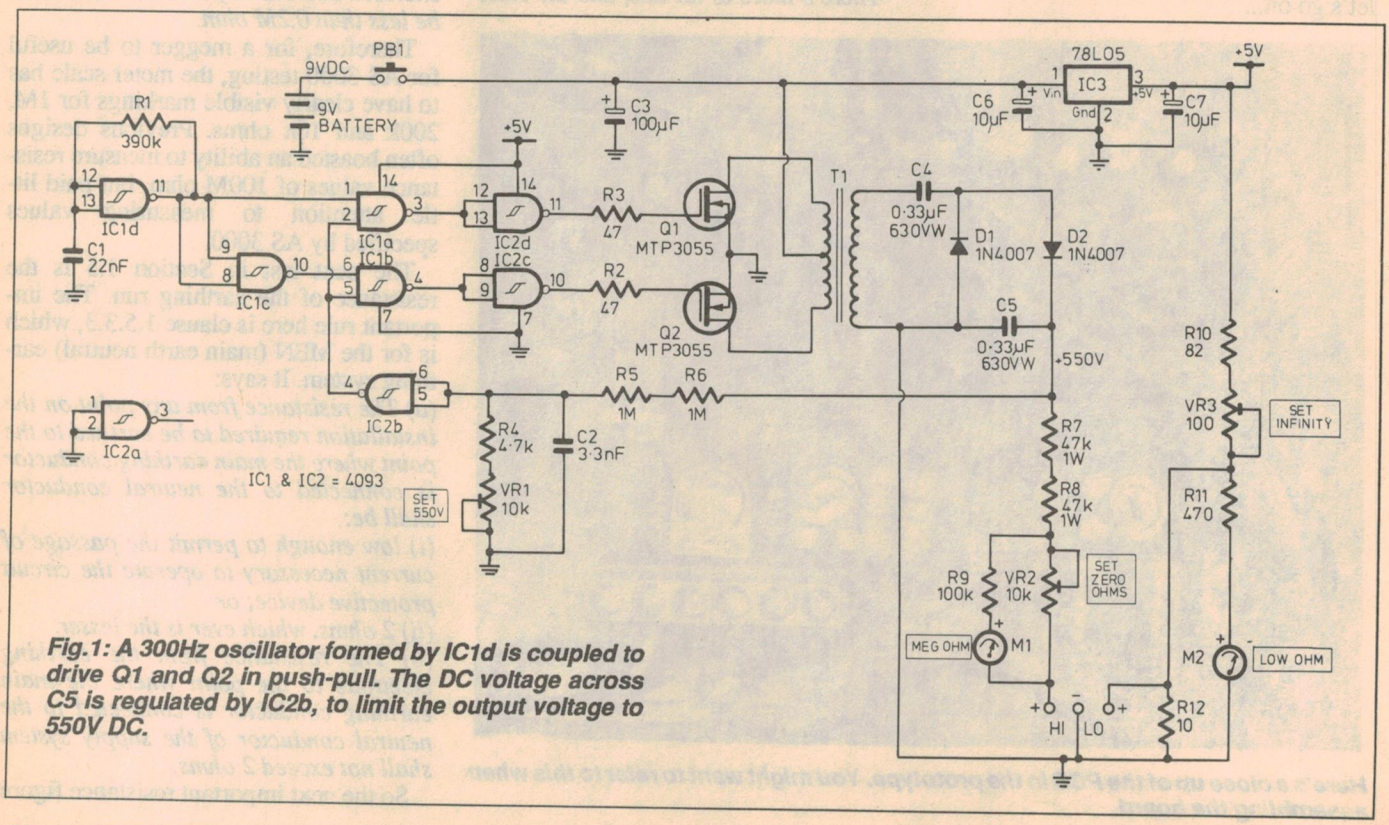


Fig.1: A 300Hz oscillator formed by IC1d is coupled to drive Q1 and Q2 in push-pull. The DC voltage across C5 is regulated by IC2b, to limit the output voltage to 550V DC.

two gates means that Q2 is switched off when the oscillator output is low. Therefore, only one MOSFET is on at a time, giving a push-pull switching action.

When Q1 is on, current flows from the supply to ground via the top half of the primary winding of T1. When Q2 is on, current flows in the bottom half of the winding. The direction of these currents are opposite and because they are switching on and off at 300Hz or so, an AC voltage is induced in the secondary of T2.

Notice that gates IC1a and IC1b are controlled by the output of IC2b. When the output from IC2b is high, these gates are enabled and respond to the output of the oscillator. However, when the output of IC2b is low, IC1a-b are disabled, with their outputs high, regardless of the oscillator output. Therefore both MOSFETs are off. This is how the circuit is regulated, as we can now explain.

The AC output of the step-up transformer is applied to a cascade voltage doubler circuit made up by components D1, D2, C4 and C5. Without regulation, the inverter will charge the final storage capacitor C5 to over 900V. However, when the voltage across C5 reaches 550V (as set by VR1) the voltage divider action of R5, R6 R4 and VR1 produces a voltage recognised as a logic high by the input of gate IC2b. At this point, the output of IC2b goes low and, as already described the MOSFETs are turned off.

The circuit therefore regulates itself to give an unloaded output voltage of around 550V. This voltage will fall to 500V or so under load, but the regulation prevents an excessively high unloaded voltage.

The regulated DC voltage is coupled to the test circuit via meter M1 and associated components. Any current flowing in the circuit under test is indicated by the meter. The meter is calibrated with VR2, which is adjusted for full scale deflection when a short circuit is applied to the output terminals.

The low resistance section is independent of the rest of the circuit and is supplied with 5V DC via three-terminal regulator IC3. The 5V supply also powers the CMOS gates, which draw negligible power anyway.

When pushbutton PB1 is pressed, the 9V battery is connected to the circuit and, if VR3 is adjusted correctly, meter M2 will read full scale. If the battery voltage falls below 7V or so, the 2V headroom needed by IC3 will be exceeded, and its output voltage will fall below 5V. The pointer of M2 will therefore drop below full scale, giving an indication that the batteries need changing. When a resistance is connected to the low ohms terminals, some of the current normally flowing in M2 is diverted through this resistance. A short-circuit at the terminals will divert all the current, giving zero deflection of the pointer. Higher values of resistance divert less current, with a subsequently higher reading.

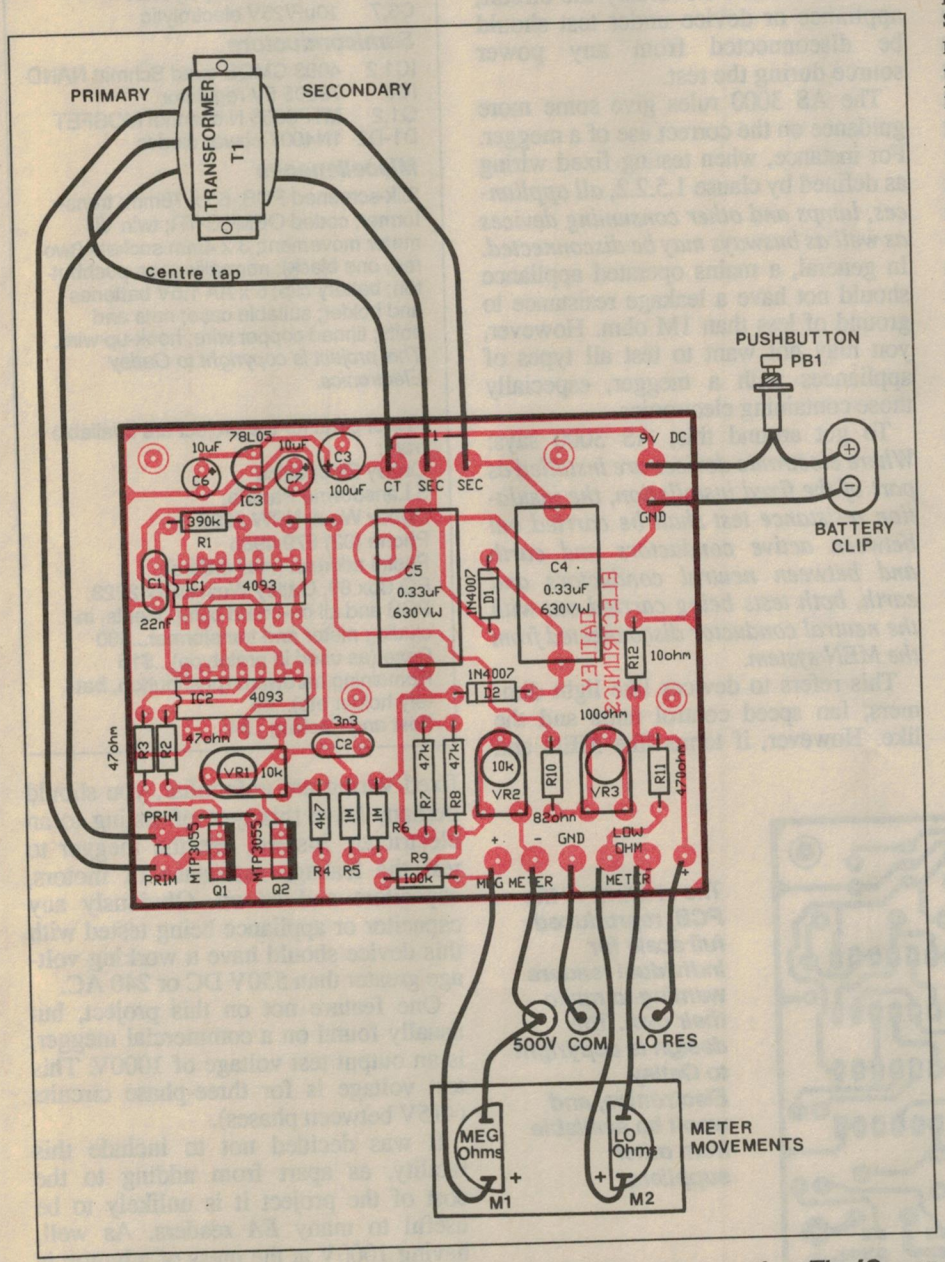


Fig.2: This layout and the photos show how everything fits together. The ICs can be directly soldered to the PCB. Momentarily earth yourself before handling the CMOS ICs and the MOSFETs, to prevent damage due to electrostatic discharge.

Construction

As the photos show, the unit is very simple to build. The choice of case is up to you, limited only by the space requirements of the battery pack, the transformer and the PCB.

Construction of the PCB is straightforward. There's one link near Q1, which is best fitted before fitting Q1. Otherwise follow the layout diagram in Fig.2. Make sure the polarity of the electrolytic capacitors and the diodes is correct, and that you use 1W resistors for R7 and R8. Also, check that Q1 and Q2 are fitted as shown in the layout diagram, with their metal tabs towards R4.

Once the board is assembled connect the rest of the components. Notice that the pushbutton is in series with the battery pack. Make sure you get the polarity of the battery pack correct, as there's no reverse polarity protection in the circuit.

You'll need to cut a rectangle for the meter movement in the front panel of the

An Insulation Resistance Tester

case. The meter can be fixed to the panel with double-sided tape. Also drill holes for the terminals and the pushbutton.

Testing

It's most important to realise that this circuit can deliver a high voltage at quite substantial currents. It can therefore give a nasty shock — so **be careful!**

After you've completed and checked the assembly and wiring, fit six size AA batteries to the battery pack. Also set all the pots half way, especially VR1. You might like to monitor the current taken from the battery, to confirm the circuit is working correctly. You should measure a current of between 50mA to 100mA taken by the circuit when it's unloaded. The current might vary considerably, due to the regulating action of the feedback.

Connect a voltmeter to the high resistance terminals and adjust VR1 to give 550V DC on no-load. Then connect a 1M ohm resistor across the terminals and confirm the voltage is around 500V. If not, readjust VR1 accordingly. If as a result you find the unloaded output voltage is much higher than 550V, you probably have a mistake in your construction.

As a guide, the prototype takes around 140mA when a 1M ohm load is connected. Again this current will vary somewhat. If all is working correctly, connect a short-circuit across the output terminals and adjust VR2 to give full scale deflection (zero ohms) for M1.

The final adjustment is VR3. Here you simply adjust this pot so the pointer of M2 (low ohms meter) is at full scale deflection (maximum ohms) when there's nothing connected to the low ohms terminals. Then fit a scale to the meters. The artwork used for the prototype is shown in Fig.3. Either use it directly, via a photocopier, or as a guide to making your own.

Using the megger

To use the tester to measure insulation resistance, simply connect the test leads (from the 500V terminal and common) to the circuit and press the button. Check that the 9V battery is OK by noting that the low ohms meter reads full scale. Obviously the circuit, appliance or device under test should be disconnected from any power source during the test.

The AS 3000 rules give some more guidance on the correct use of a megger. For instance, when testing fixed wiring as defined by clause 1.5.2.2, *all appliances, lamps and other consuming devices as well as busways may be disconnected.* In general, a mains operated appliance should not have a leakage resistance to ground of less than 1M ohm. However, you may not want to test all types of appliances with a megger, especially those containing electronics.

To get around this, AS 3000 says: *Where electronic devices are installed as part of the fixed installation, the insulation resistance test shall be carried out between active conductors and earth and between neutral conductors and earth, both tests being carried out with the neutral conductor disconnected from the MEN system.*

This refers to devices like light dimmers, fan speed control units and the like. However, if terms like MEN and fixed wiring are unfamiliar, you should perhaps leave this type of testing to an electrician. Instead, use the megger to test the leakage resistance of motors, capacitors and so on. Obviously any capacitor or appliance being tested with this device should have a working voltage greater than 550V DC or 240 AC.

One feature not on this project, but usually found on a commercial megger, is an output test voltage of 1000V. This test voltage is for three-phase circuits (415V between phases).

It was decided not to include this facility, as apart from adding to the cost of the project it is unlikely to be useful to many *EA* readers. As well, having 1000V at the press of a button is likely to create its own special hazards — which most readers would probably sooner do without. ❖

PARTS LIST

Resistors

All 1/4W:

R1	390k
R2,3	47 ohm
R4	4.7k
R5,6	1M
R7,8	47k, 1W
R9	100k
R10	82 ohm
R11	470 ohm
R12	10 ohm
RV1,2	10k trimpot
RV3	100 ohm trimpot

Capacitors

C1	22nF ceramic
C2	3.3nF ceramic
C3	100uF/25V electrolytic
C4,5	0.33uF/630V polyester
C6,7	10uF/25V electrolytic

Semiconductors

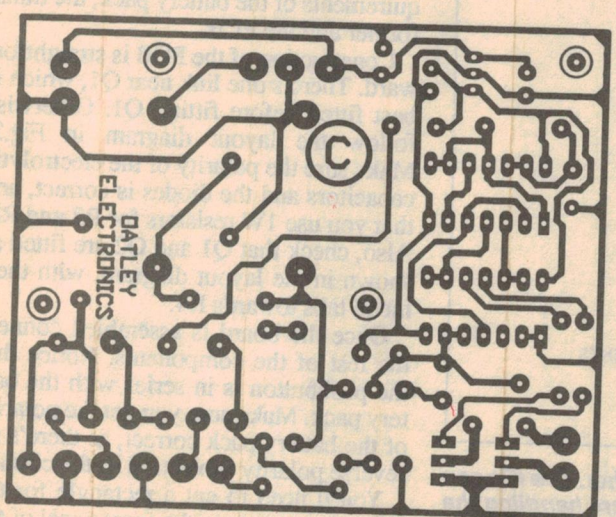
IC1,2	4093 CMOS quad Schmitt NAND
IC3	78L05 5V regulator
Q1,2	MTP3055 N channel MOSFET
D1-D2	1N4007 power diodes

Miscellaneous

Silk-screened PCB, 65 x 78mm; transformer, coded OEMEG-TR; twin VU meter movement; 3 x 4mm sockets (two red, one black); normally-open pushbutton; battery clip; 6 x AA 1.5V batteries and holder; suitable case; nuts and bolts; tinned copper wire; hook-up wire.

This project is copyright to Oatley Electronics.

Kits of parts for the project are available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.
PCB and all on-board components, including meter and transformer...$30
Case (as used in prototype)...$15
Remaining hardware (pushbutton, battery holder etc)...$5
Post and Packing...$4



The artwork of the PCB, reproduced full scale for individual readers wanting to make their own. The design is copyright to Oatley Electronics, and won't be available from other suppliers.

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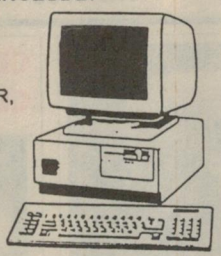
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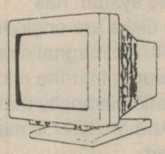
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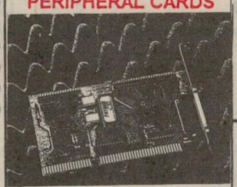
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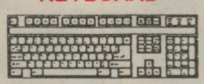
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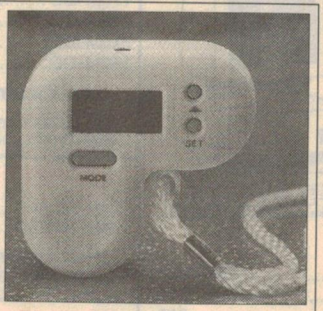


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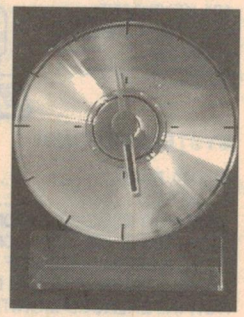
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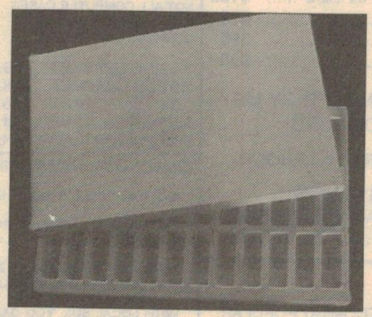
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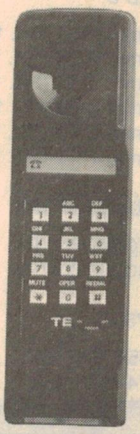
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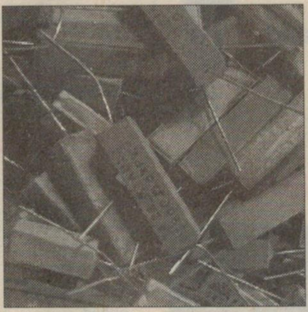
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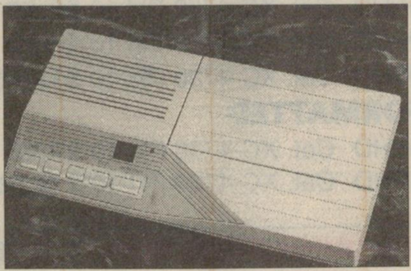
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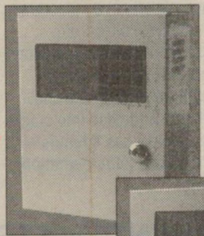
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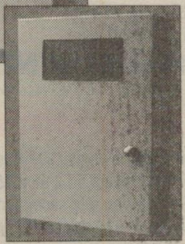
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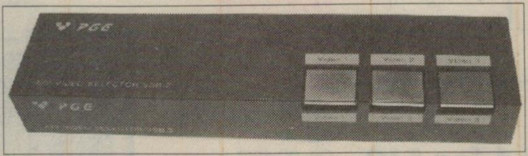
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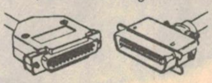
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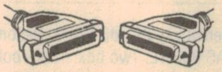
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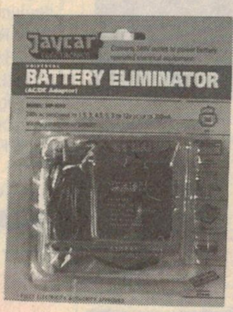
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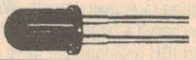
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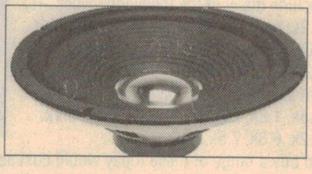


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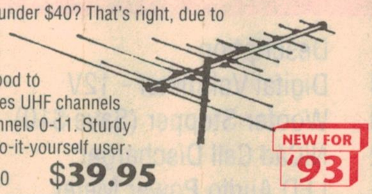
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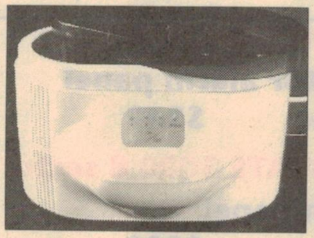
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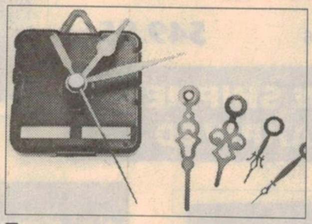
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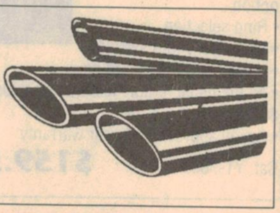
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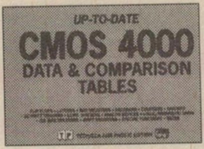


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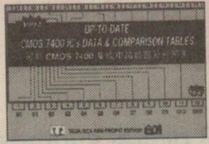
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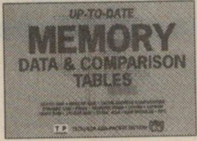
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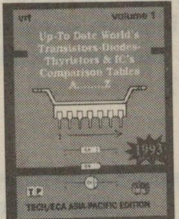
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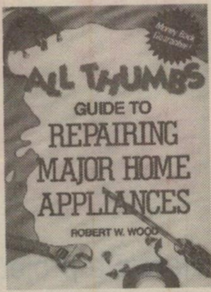


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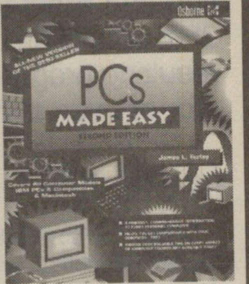
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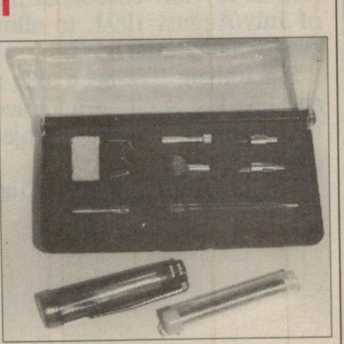
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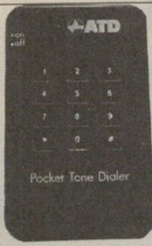
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Construction Project:

PC driven 0-12MHz Digital Synthesiser

Here's a project which teams the Novatech DDS3 digital synthesiser kit with a PC interface, so that you can program it very easily from the PC keyboard to produce any desired frequency between 2Hz and 12MHz, in 2Hz increments. Since the DDS3 produces both sine and square waves, the resulting programmable generator can be used as a precision frequency calibrator, a function generator or even a sweep generator.

by JIM ROWE

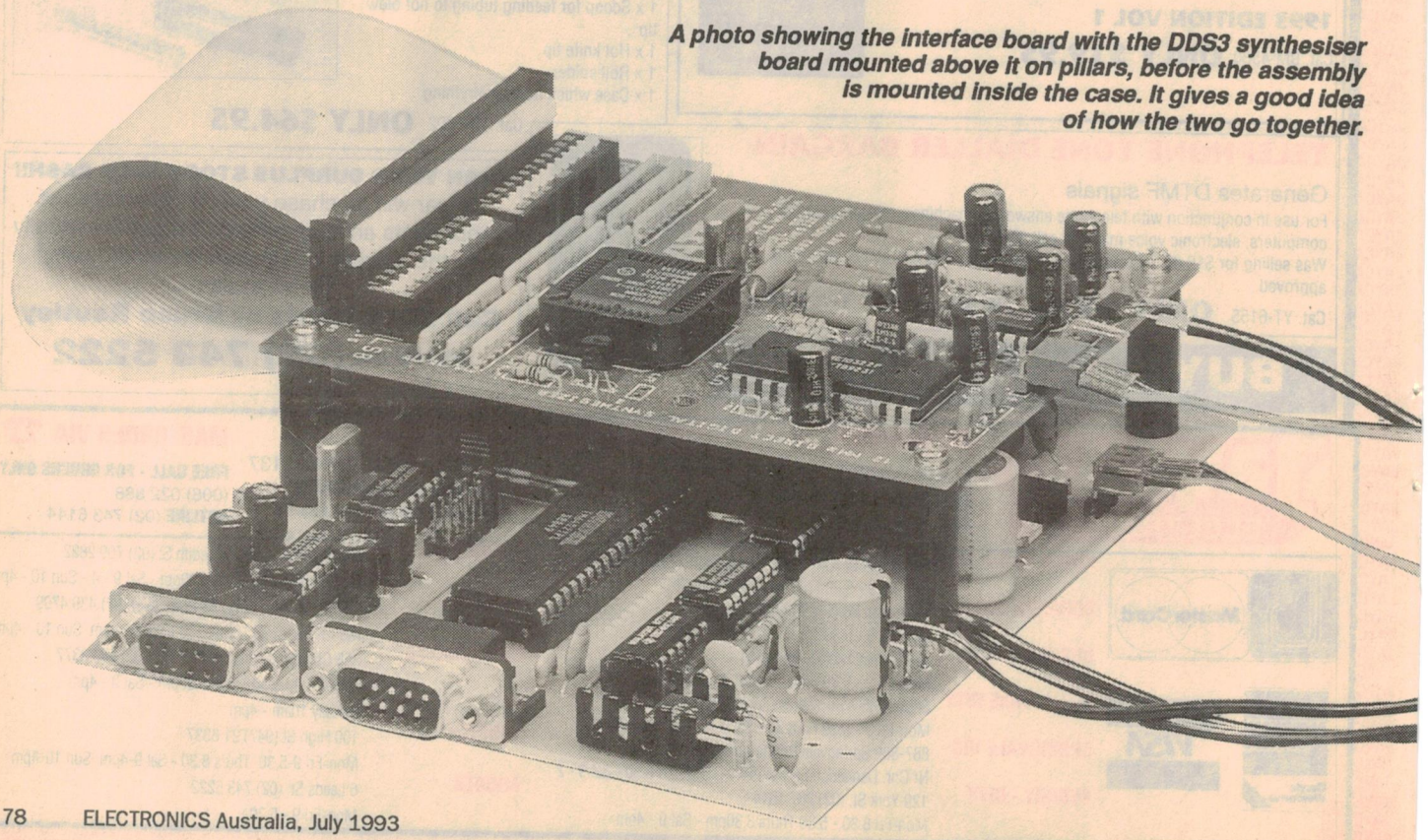
When I reviewed the Novatech DDS3 digital frequency synthesiser kit in the April issue, I suggested that it shouldn't be too difficult to design a modified version of my low cost serial I/O interface of July/August 1991, to allow it to be programmed from a PC.

Since then, I've been able to develop and test just such an interface, and this has resulted in the project to be described here.

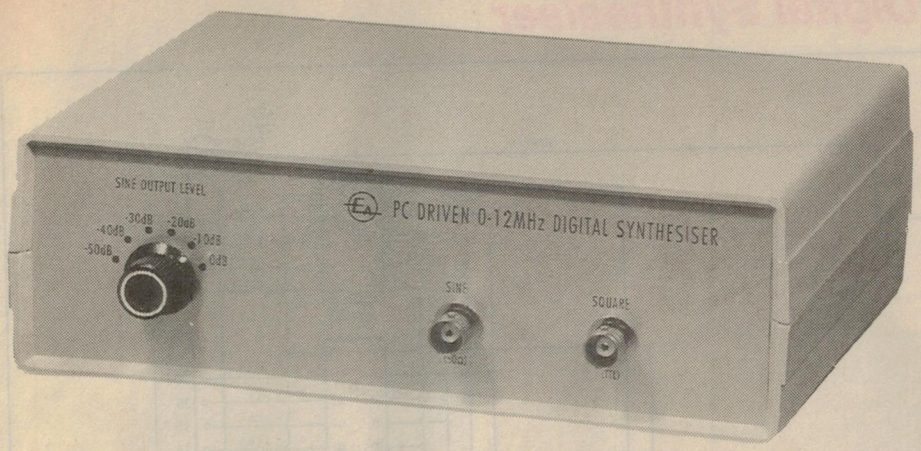
The output frequency of the DDS3 is programmed by means of a parallel 23-bit binary word, you may recall, and the new interface is designed to allow these 23-bit binary numbers to be sent out from the PC via the normal RS-232C serial port, in the form of a sequence of six four-bit nibbles. On the arrival of the sixth nibble, a 'hop clock' pulse is fed to the DDS3, so that it loads the assembled 23-bit word into its synthesiser chip and produces the corresponding new output frequency.

Actually, the interface converts simply coded RS-232C serial data into a 24-bit parallel word — the 24th bit is used here for control of the synthesiser's OBN line, to determine whether its output is bipolar or unipolar. This means, by the way, that the interface could also be used for other applications where you need to program 24 digital control lines via a PC's serial port.

As the Qualcomm Q2220 synthesiser chip used in the DDS3 kit can change



A photo showing the interface board with the DDS3 synthesiser board mounted above it on pillars, before the assembly is mounted inside the case. It gives a good idea of how the two go together.



frequency in less than 250ns, this means that it can potentially change frequency up to four million times per second — and in a phase-continuous fashion! This gives it great potential for things like frequency sweeping, frequency-shift keying, spread-spectrum signal generation and so on.

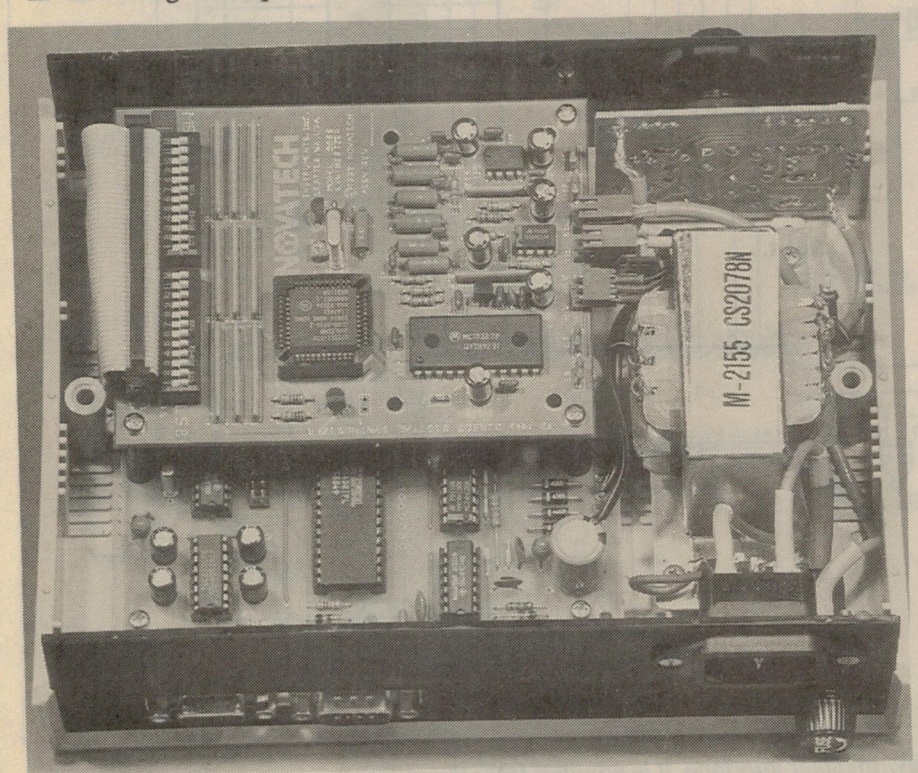
Unfortunately it isn't easy to achieve this potential using a simple serial interface from a PC — we're limited by the rate that we can feed new 24-bit numbers out to it. With the basic interface described here, for example, running at its top speed of 9600bps, we can only actually make 160 frequency changes per second.

In fact using a simple GW-BASIC program like that shown later in the article, the maximum rate falls to about 33 frequency changes per second.

While this is OK for audio sweeping applications, it's really a bit too slow for things like sweeping IF filters — unless you use a storage scope or DSO to capture the output signal. There are a number of possible ways to speed things up, though, and I'll discuss these briefly later.

The bottom line is that by letting you program the DDS3 output frequency easily using your PC keyboard, the new interface really opens up the possibilities of using it for a wide variety of applications.

With your PC as the synthesiser's control panel and 'user interface', you can really make it jump through hoops!



An overall view looking inside the case, showing how the transformer and small attenuator board are mounted alongside the main board assembly.

How it works

Much of the interface circuitry is unchanged from the original, as published in the July 1991 issue. A MAX232/TSC232 chip (U5) is used as the RS-232C serial interface driver/-receiver, with a standard AY-3-1015D UART chip (U1) used for serial/parallel and parallel/serial conversion. Note that the 'transmit' section of U1 is not actually required for controlling the DDS3, and its parallel data input lines are in fact all linked to ground on the PCB. However the PCB tracks can be easily cut to enable the inputs, if you need them for other applications.

The clock signals needed by the UART receiver and transmitter sections are supplied by U4, a 74HC4060. The oscillator section of this chip operates at 2.4576MHz, as determined by crystal X1, and this allows the Q4 - Q9 outputs to provide the correct clock frequencies for data rates of 9600 - 300bps. Selection of the desired date rate is done by moving LK2, a jumper shunt. When used with the DDS3, LK2 will normally be fitted in the 9600bps position.

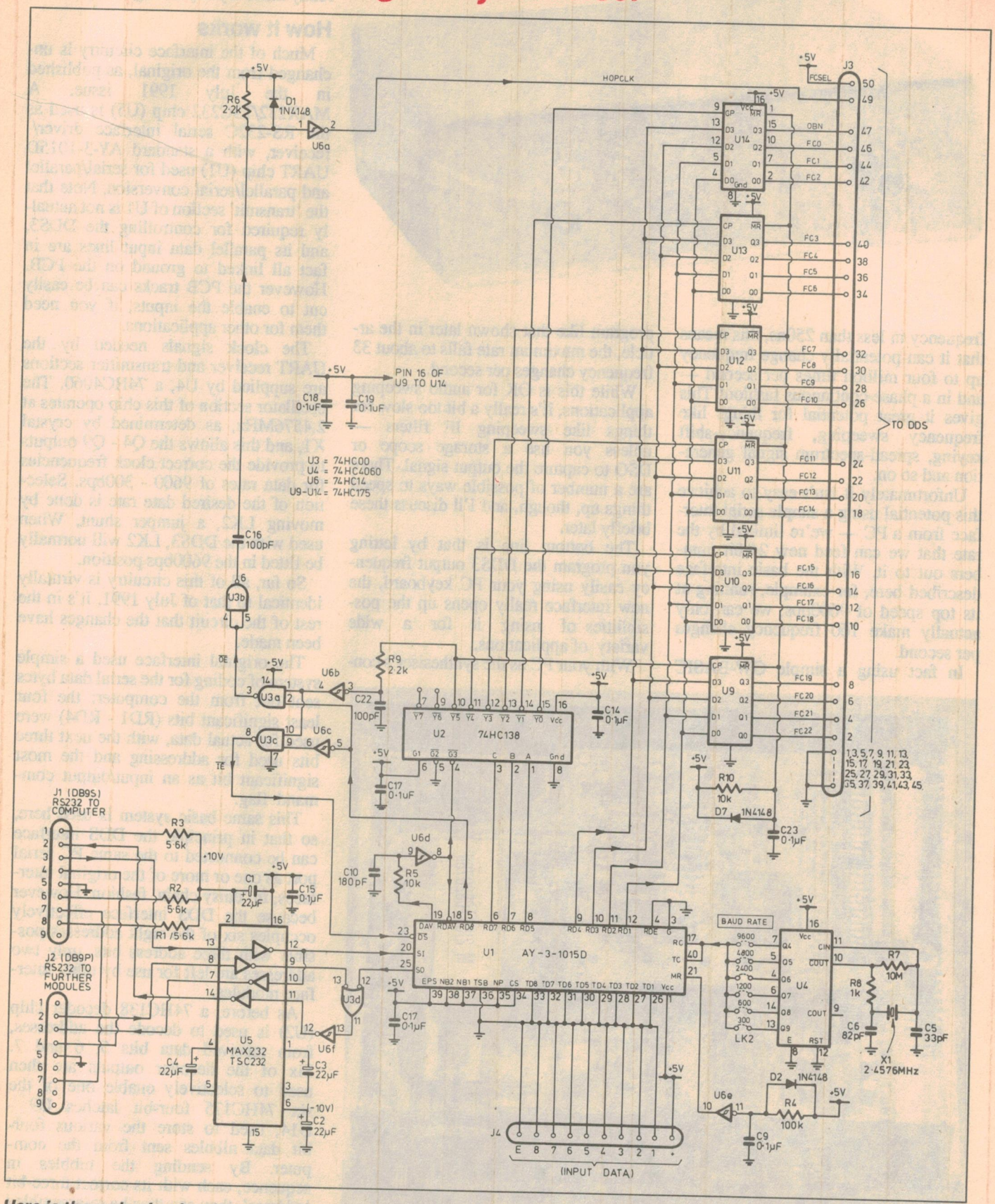
So far, all of this circuitry is virtually identical to that of July 1991. It's in the rest of the circuit that the changes have been made.

The original interface used a simple system of coding for the serial data bytes sent out from the computer: the four least significant bits (RD1 - RD4) were used for actual data, with the next three bits used for addressing and the most significant bit as an input/output command flag.

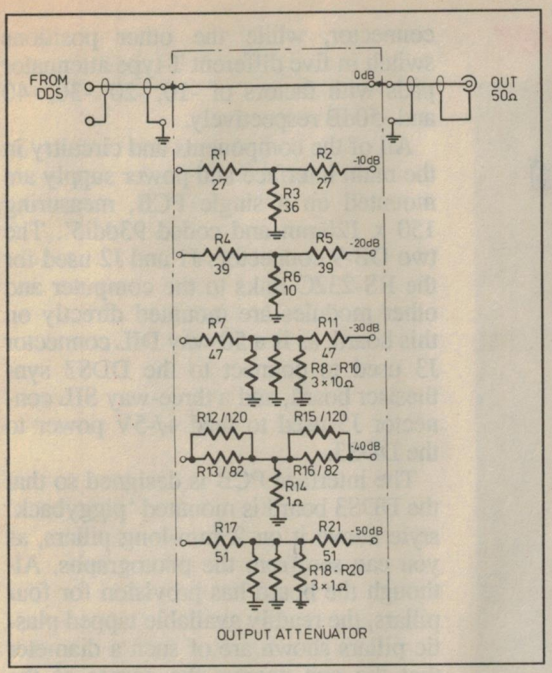
This same basic system is used here, so that in principle the DDS interface can be connected to the same PC serial port as one or more of the original interfaces, in 'daisy chain' fashion. However because the DDS interface effectively occupies six of the eight addresses possible with three address bits, only two addresses are left for use by other interface modules.

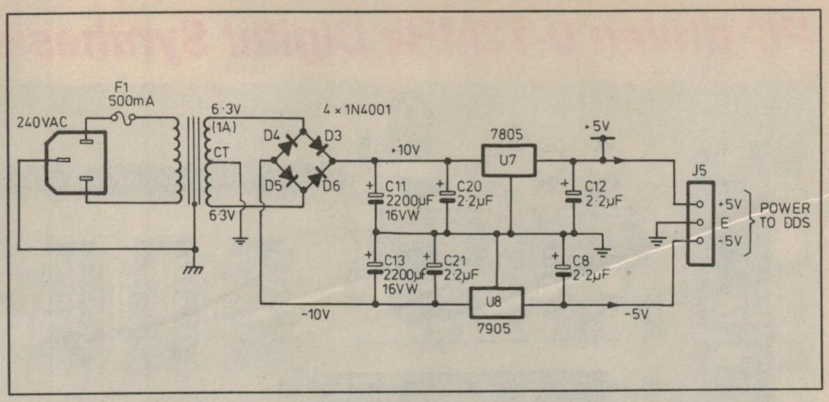
As before, a 74HC138 decoder chip (U2) is used to decode the addresses, from received data bits 5, 6 and 7. Six of the decoder outputs are then used to selectively enable one of the six 74HC175 four-bit latches U9 - U14, used to store the various four-bit data nibbles sent from the computer. By sending the nibbles in sequence, each with its correct three-bit 'address', they can thus be re-assembled in the latches to make a complete 24-bit command word.

PC driven 0-12MHz Digital Synthesiser



Here is the main circuit schematic for the synthesiser interface. It is adapted from the author's previous I/O interface, and uses the same RS-232C transmitter receiver (U5) UART (U1) and baud rate generator (U4). In this case the received data is latched into U9 - U14, to produce a 24-bit parallel data word for programming the digital synthesiser.





Above: The schematic for the power supply section. As you can see, it's quite straightforward, producing plus and minus 5V. Both supplies are used for the DDS3 board, while the plus 5V is used for the interface circuitry.

Left: The schematic for the output attenuator. This is used to provide five lower sinewave output levels in addition to the full output from the DDS3 board itself. The output can thus be switched in 10dB steps, while remaining at a constant 50 ohms impedance.

Fig.1 shows the basic serial data format used, and also the relationship between the nibble addresses, the data latch chips and the various DDS command word bits.

Needless to say we don't want the DDS to respond to the data stored in the latches until all 24 bits have been assembled for a new frequency — otherwise, the DDS would jump back and forth through a number of spurious transmission frequencies, as the various nibbles are updated.

To prevent this happening we hold the DDS 'FC SELECT' line (pin 50) high, so that it only responds to the command word on the rising edge of a strobe pulse, fed to its 'HOP CLK' input. We then generate this strobe pulse only when the *last* of the six nibbles has been received, and stored in its latch U9.

The DDS strobe pulse is generated by taking the output pulse from the output of U2 used to select U9, and delaying it via R9 and C22 to allow time for the data to be latched into U9. The delayed pulse is then fed through inverter U6b, gate U3a, inverter U3b, differentiator formed by C16 and R6 (used to select the trailing edge) and finally inverter U6a. The end result is a positive-going pulse approximately 200ns wide, delayed by 250ns after the trailing edge of the 1us selection pulse fed to U9.

Note that this DDS strobe pulse is only produced following the arrival of the final data nibble, directed to latch U9 — and then only when the serial data byte's most significant bit RD8 is set high, corresponding to an 'output data' byte.

The remaining sections of the interface circuit are used to perform basic 'housekeeping' functions. R4, C9, D2 and U6e are used to reset the UART on power-up, while R10, C23 and D7 perform the same function for the data latch chips. This ensures that when power is first applied to the interface and DDS3, there is no spurious output. In fact there is no output from the DDS3 at all, until the first sequence of six data bytes is sent from the computer.

Resistor R5, capacitor C10 and inverter U6d are used both to reset the UART's 'Data Available' output, following the arrival of each data byte, and also to produce the 1us pulses used to gate decoder U2 — and hence produce the latch selection and DDS strobe pulses.

Note that when the most significant bit of a data byte (RD8) from the computer is set low, U3a is disabled to prevent the generation of a DDS strobe pulse. At the same time, U3c is enabled by inverter U6c, so the delayed pulse from U6b is fed instead to pin 23 of the UART — causing it to transmit a serial byte back to the computer.

This ability to return data to the PC is not required by the DDS3, and the PCB currently links all of the UART's transmit bit lines to ground, as shown. This means that the byte returned to the computer will consist of eight zeroes. However when the interface is used with things other than the DDS3, the ground links can be removed and real data applied to the UART input pins.

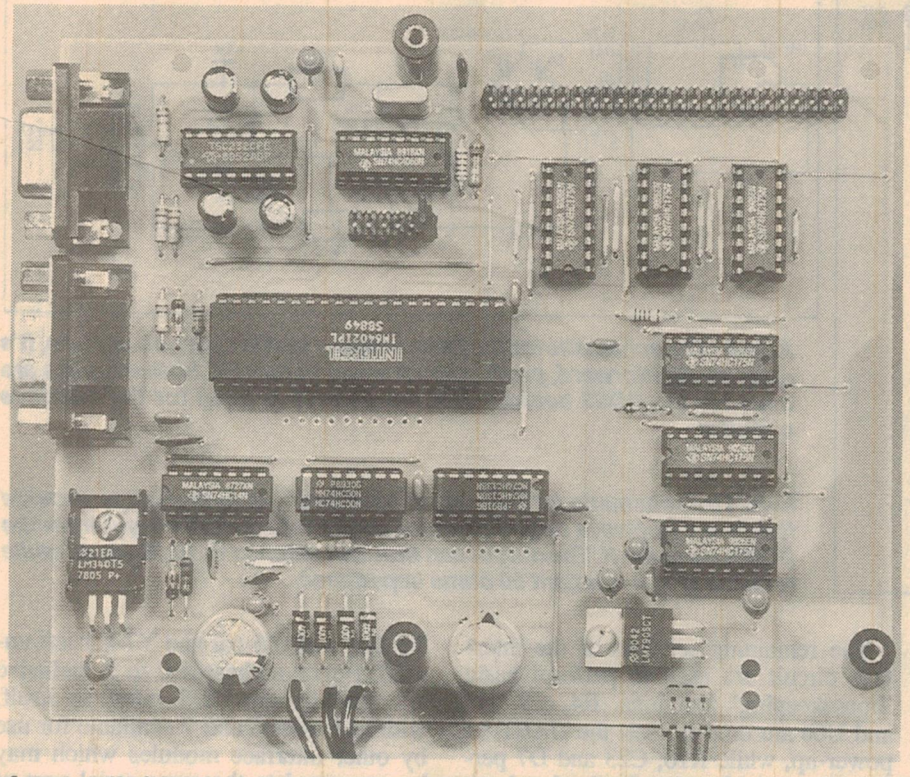
As shown in the schematic, the six outputs of U2 currently used to select the various data latches are Y0-bar to Y5-bar, with Y6-bar and Y7-bar left unused. Hence addresses 0 to 5 inclusive are used by the DDS interface itself, with addresses 6 and 7 available for use by other interface modules which may be connected to the same serial port of the PC.

Although this is probably the most convenient addressing arrangement, the interface PCB's pattern allows you to change it if you wish. You might want to do so if you've already built one or two of the original interfaces, for example, and set them up for addresses 0 and 1. In this case you can set up the DDS interface to occupy addresses 2-7, simply by cutting a few 'linking' tracks on the PCB and fitting some short wire links between the pads provided.

That's about all that needs to be said about the main part of the DDS interface circuit, I think. Power for both the interface and the DDS3 board is provided by a simple supply using a transformer with a 12.6V/1A centre-tapped secondary, a bridge rectifier and a pair of three-terminal regulator chips.

U7, a 7805 provides +5V for both the interface chips and the DDS3, while a 7905 negative regulator (U8) provides -5V for the DDS3 alone. Apart from the power transformer and mains wiring, the rest of the power supply circuitry is mounted on the interface PCB to simplify wiring.

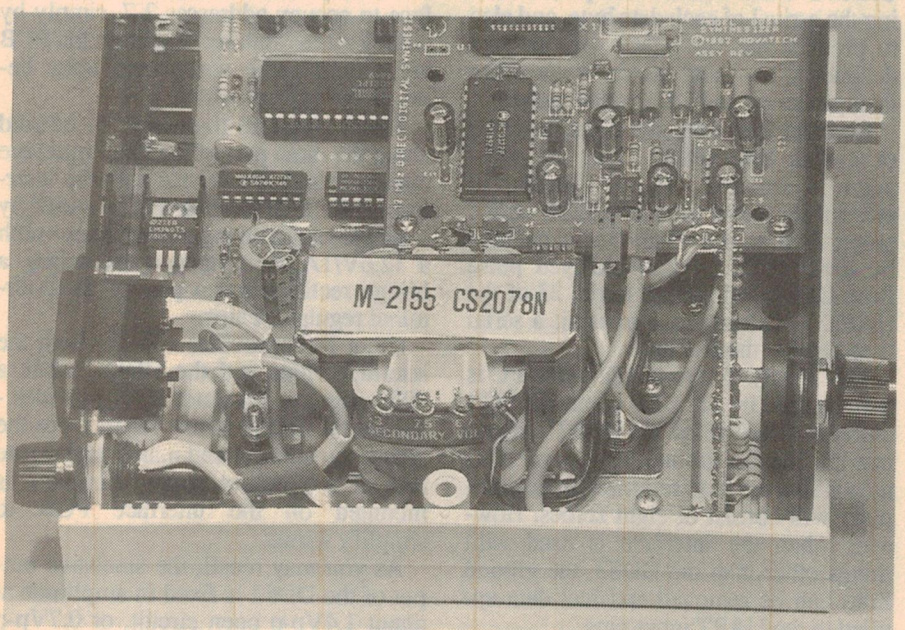
As you may recall, the sinewave output of the DDS3 is fixed in amplitude at about 1.4Vp-p open circuit, or 0.7Vp-p into a 50-ohm load. To make the final generator a little more flexible, I have designed a small step attenuator which



An overall view of the interface board before the DDS3 board is mounted on the top, to show where everything goes. Note that the board shown is slightly different from the final pattern, and also uses IC sockets for all chips — which is not really necessary. Only the UART chip U1 really needs a socket.

allows this raw output to be reduced in five 10dB increments, while still retaining the 50- ohm output impedance.

To keep the attenuator as compact as possible, it's based on a readily available two-pole x 6 positions rotary switch rather than the usual array of toggle switches. In the 0dB 'maximum output' position the DDS3 output signal is passed straight through to the output connector, while the other positions switch in five different T-type attenuator pads with factors of -10, -20, -30, -40 and -50dB respectively.



A close-up view of the transformer end of the case, showing the mains wiring with protective sleeves over all joints to prevent accidental contact. Also visible is the attenuator board assembly on the right.

All of the components and circuitry in the main interface and power supply are mounted on a single PCB, measuring 150 x 120mm and coded 93ddi5'. The two DB-9 connectors J1 and J2 used for the RS-232C links to the computer and other modules are mounted directly on this board, as is a 50-way DIL connector J3 used to connect to the DDS3 synthesiser board, and a three-way SIL connector J5 used to feed +/-5V power to the DDS3.

The interface PCB is designed so that the DDS3 board is mounted 'piggyback' style above it on 25mm-long pillars, as you can see from the photographs. Although the board has provision for four pillars, the readily available tapped plastic pillars shown are of such a diameter that the one nearest the corner of the board adjacent to J3 cannot be fitted, without fouling the mating IDC connector. This is no great problem, though, as the DDS3 board is quite light, and three pillars support it adequately.

The complete main double-PCB assembly is designed to fit in a standard low-cost plastic instrument case measuring 200 x 165 x 65mm (or 70mm), as shown. The output attenuator components are mounted on a further small PCB, measuring 63 x 54mm and coded 93swa6.

This mounts directly on the back of the rotary switch, and the pair just squeeze in alongside the dual board assembly, after a small notch is cut in the lower right-hand corner of the attenuator PCB to clear the main interface board.

The power transformer is bolted onto a 100 x 40mm plate of 1mm aluminium sheet, mounted in turn inside the case just behind the attenuator. There isn't much free space inside the case, but everything fits in — just.

Construction

Building the interface and complete generator should be relatively easily, assuming you have already obtained the Novatech DDS3 kit and now have it assembled and tested, according to Novatech's instructions.

(By the way, the interface kit has been designed taking into account the *true* connections to the DDS3 50-way connector, not those shown in their original instructions.)

The first step is to assemble the interface PCB itself, using the schematic, overlay diagram and photographs as a guide. As usual it's best to fit the wire

Listing 1

```
10 DEFINT A-N: DEFDBL S-Z: DIM A(5): OPEN "COM1: 9600,N,8,1,CS0,DS0,BIN" AS #1
20 KEY OFF:CLS: GOSUB 4000: 'Set up screen
30 GOSUB 2000: 'Go set up array of binary weight constants
40 FOR N=1 TO 5: A(N)=0: NEXT N: A(0)=8: 'Clear array, set OBN bit
50 GOSUB 2500: Z=X: 'Fetch frequency wanted, check for range & save copy
60 GOSUB 500: 'Now calculate corresponding binary code nibbles
70 GOSUB 1000: 'And send them off to the DDS...
80 GOSUB 3000: 'Then display current frequency
90 GOTO 40: 'And back to look for a new frequency to send
500 IF X>=Y(22) THEN A(5)=A(5)+1: X=X-Y(22): 'Now calc DDS code nibbles
510 IF X>=Y(21) THEN A(5)=A(5)+2: X=X-Y(21)
520 IF X>=Y(20) THEN A(5)=A(5)+4: X=X-Y(20)
530 IF X>=Y(19) THEN A(5)=A(5)+8: X=X-Y(19)
540 IF X>=Y(18) THEN A(4)=A(4)+1: X=X-Y(18)
550 IF X>=Y(17) THEN A(4)=A(4)+2: X=X-Y(17)
560 IF X>=Y(16) THEN A(4)=A(4)+4: X=X-Y(16)
570 IF X>=Y(15) THEN A(4)=A(4)+8: X=X-Y(15)
580 IF X>=Y(14) THEN A(3)=A(3)+1: X=X-Y(14)
590 IF X>=Y(13) THEN A(3)=A(3)+2: X=X-Y(13)
600 IF X>=Y(12) THEN A(3)=A(3)+4: X=X-Y(12)
610 IF X>=Y(11) THEN A(3)=A(3)+8: X=X-Y(11)
620 IF X>=Y(10) THEN A(2)=A(2)+1: X=X-Y(10)
630 IF X>=Y(9) THEN A(2)=A(2)+2: X=X-Y(9)
640 IF X>=Y(8) THEN A(2)=A(2)+4: X=X-Y(8)
650 IF X>=Y(7) THEN A(2)=A(2)+8: X=X-Y(7)
660 IF X>=Y(6) THEN A(1)=A(1)+1: X=X-Y(6)
670 IF X>=Y(5) THEN A(1)=A(1)+2: X=X-Y(5)
680 IF X>=Y(4) THEN A(1)=A(1)+4: X=X-Y(4)
690 IF X>=Y(3) THEN A(1)=A(1)+8: X=X-Y(3)
700 IF X>=Y(2) THEN A(0)=A(0)+1: X=X-Y(2)
710 IF X>=Y(1) THEN A(0)=A(0)+2: X=X-Y(1)
720 IF X>=Y(0) THEN A(0)=A(0)+4
730 RETURN
1000 FOR N=0 TO 5:'Routine to send code nibbles to DDS
1010 PRINT #1, CHR$(128 + (16*N) + A(N));
1020 NEXT N: RETURN
1030 REM
2000 DIM Y(22): 'Set up array for binary weight constants (Dbl precision)
2010 FOR N=0 TO 22: Y(N)=2#^(N+1): NEXT N: 'And give them their values...
2020 RETURN
2040 REM
2500 LOCATE 20,60:PRINT STRING$(9,32);: 'Fetch new frequency required
2510 LOCATE 20,20:INPUT "What is the desired new frequency (Hz)"; X
2520 IF X>14000000# THEN LOCATE 20,60:PRINT "Too high!";:GOSUB 2600:GOTO 2500
2530 RETURN
2540 REM
2600 FOR N=1 TO 2000:NEXT N: RETURN: 'Short delay...
2610 REM
3000 COLOR 12,1:LOCATE 12,31: PRINT STRING$(19,32);:'Display updated frequency
3010 COLOR 12,1:LOCATE 12,35:PRINT USING "########";Z;:PRINT " Hz";
3020 COLOR 7,0:RETURN
3030 REM
4000 LOCATE 5,20:PRINT "DDS Frequency Control Program Version 3.0";
4010 LOCATE 1,1:PRINT CHR$(201); STRING$(78,205); CHR$(187);
4020 FOR N=2 TO 24:LOCATE N,1:PRINT CHR$(186);:LOCATE N,80:PRINT CHR$(186);:NEXT
4030 LOCATE 25,1:PRINT CHR$(200); STRING$(78,205); CHR$(188);
4040 COLOR 15,1:LOCATE 10,30:PRINT CHR$(201); STRING$(19,205); CHR$(187);
4050 FOR N=11 TO 13:LOCATE N,30:PRINT CHR$(186);STRING$(19,32);CHR$(186);:NEXT
4060 LOCATE 14,30:PRINT CHR$(200); STRING$(19,205); CHR$(188);
4070 COLOR 15,0:LOCATE 9,30:PRINT"CURRENT DDS FREQUENCY";:COLOR 7,0
4080 RETURN
```

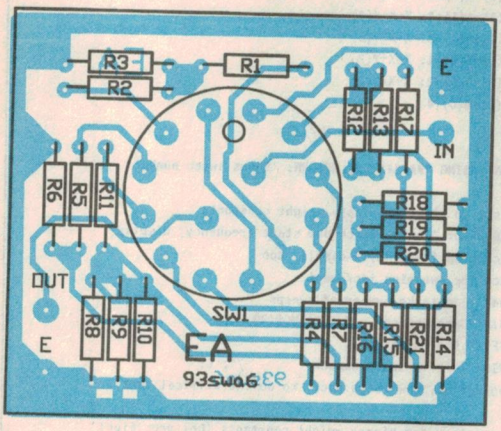
Listing 2

```
10 DEFINT A-N: DEFDBL S-Z: DIM A(5): OPEN "COM1: 9600,N,8,1,CS0,DS0,BIN" AS #1
20 KEY OFF:CLS: GOSUB 4000: GOTO 1500: 'Set up screen, move away for speed
100 FOR K=1 TO L: S=T: GOSUB 1000: 'Main sweeping loop, here for speed
110   WHILE S<=Z:X=S:GOSUB 500:GOSUB 200:GOSUB 300:S=S+U:WEND
120 NEXT K:LOCATE 17,20:PRINT "Sweeping Stopped.";STRING$(25,32);:GOTO 1510
200 FOR N=0 TO 5:PRINT #1,CHR$(128+(16*N)+A(N));:NEXT N:RETURN:'Send em!
300 LOCATE 14,47:PRINT USING "########";S;:RETURN:'Slows it down, but nice...
500 FOR N=1 TO 5: A(N)=0: NEXT N: A(0)=8: 'Clear code array, set OBN bit
510 IF X>=Y(22) THEN A(5)=A(5)+1: X=X-Y(22): 'Now calc DDS code nibbles
520 IF X>=Y(21) THEN A(5)=A(5)+2: X=X-Y(21)
530 IF X>=Y(20) THEN A(5)=A(5)+4: X=X-Y(20)
540 IF X>=Y(19) THEN A(5)=A(5)+8: X=X-Y(19)
550 IF X>=Y(18) THEN A(4)=A(4)+1: X=X-Y(18)
560 IF X>=Y(17) THEN A(4)=A(4)+2: X=X-Y(17)
570 IF X>=Y(16) THEN A(4)=A(4)+4: X=X-Y(16)
580 IF X>=Y(15) THEN A(4)=A(4)+8: X=X-Y(15)
590 IF X>=Y(14) THEN A(3)=A(3)+1: X=X-Y(14)
600 IF X>=Y(13) THEN A(3)=A(3)+2: X=X-Y(13)
610 IF X>=Y(12) THEN A(3)=A(3)+4: X=X-Y(12)
620 IF X>=Y(11) THEN A(3)=A(3)+8: X=X-Y(11)
630 IF X>=Y(10) THEN A(2)=A(2)+1: X=X-Y(10)
640 IF X>=Y(9) THEN A(2)=A(2)+2: X=X-Y(9)
650 IF X>=Y(8) THEN A(2)=A(2)+4: X=X-Y(8)
660 IF X>=Y(7) THEN A(2)=A(2)+8: X=X-Y(7)
670 IF X>=Y(6) THEN A(1)=A(1)+1: X=X-Y(6)
680 IF X>=Y(5) THEN A(1)=A(1)+2: X=X-Y(5)
690 IF X>=Y(4) THEN A(1)=A(1)+4: X=X-Y(4)
700 IF X>=Y(3) THEN A(1)=A(1)+8: X=X-Y(3)
710 IF X>=Y(2) THEN A(0)=A(0)+1: X=X-Y(2)
720 IF X>=Y(1) THEN A(0)=A(0)+2: X=X-Y(1)
730 IF X>=Y(0) THEN A(0)=A(0)+4
740 RETURN
750 REM
1000 LOCATE 17,43:PRINT USING "#####"; K;:RETURN: 'Shows sweep number
1010 REM
1500 GOSUB 2000: 'Go set up array of binary weight constants
1510 GOSUB 5010: GOSUB 2500: 'Pause, fetch new start frequency, display
1520 GOSUB 3000: 'Fetch stop frequency & display too
1530 GOSUB 3600: 'Fetch the sweeping increment
1540 GOSUB 3500: 'Finally, get the number of sweeps
1550 LOCATE 20,20: PRINT"Sweeping now..."; STRING$(30,32);
1560 COLOR 12,1:LOCATE 14,56: PRINT"Hz";
1570 LOCATE 17,20: PRINT"This is sweep number          /"; L;
1580 GOTO 100: 'Having set up, now we go back, to do the critical part...
1590 REM
2000 DIM Y(22): 'Set up array for binary weight constants (Dbl precision)
2010 FOR N=0 TO 22: Y(N)=2#^(N+1): NEXT N: 'And give them their values...
2020 RETURN
2040 REM
2500 LOCATE 20,60:PRINT STRING$(12,32);:'Fetching start frequency
2510 LOCATE 20,20:INPUT "What is the desired start frequency (Hz)"; T
2520 IF T>14000000# THEN GOSUB 5000: GOTO 2500
2530 COLOR 12,1:LOCATE 8,47:PRINT USING "########";T;:PRINT" Hz";:COLOR 7,0
2540 RETURN
2550 REM
3000 LOCATE 20,60:PRINT STRING$(12,32);:'Fetching stop frequency
3010 LOCATE 20,20:INPUT "What is your desired stop frequency (Hz)"; Z
3020 IF Z>14000000# THEN GOSUB 5000: GOTO 3000
3030 IF Z<=T THEN LOCATE 20,20:PRINT"Not higher than your start!"; STRING$(20,32
);:GOSUB 5010:GOTO 3000
3040 COLOR 12,1:LOCATE 10,47:PRINT USING "########";Z;:PRINT" Hz";:COLOR 7,0
3050 RETURN
3500 LOCATE 20,60: PRINT STRING$(12,32);: 'Fetching number of sweeps
3510 LOCATE 20,20:INPUT "How many frequency sweeps do you want "; L
3520 RETURN
3530 REM
3600 LOCATE 20,60:PRINT STRING$(12,32);: 'Fetching frequency increment
3610 LOCATE 20,20:INPUT "And what is the frequency increment (Hz)"; U
3620 IF U<2# THEN U=2#
3630 IF (U+T)>Z THEN GOSUB 5000:GOTO 3600
3640 COLOR 12,1:LOCATE 12,47:PRINT USING "########";U;:PRINT" Hz";:COLOR 7,0
3650 RETURN
4000 LOCATE 4,20:PRINT "DDS Frequency Sweeping Program Version 2.0";
4010 LOCATE 1,1:PRINT CHR$(201); STRING$(78,205); CHR$(187);
4020 FOR N=2 TO 24:LOCATE N,1:PRINT CHR$(186);:LOCATE N,80:PRINT CHR$(186);:NEXT
4030 LOCATE 25,1:PRINT CHR$(200); STRING$(78,205); CHR$(188);
4040 COLOR 15,1:LOCATE 7,42:PRINT CHR$(201);STRING$(18,205);CHR$(187);
4050 FOR N=8 TO 14:LOCATE N,42:PRINT CHR$(186);STRING$(18,32);CHR$(186);:NEXT
4060 LOCATE 15,42: PRINT CHR$(200);STRING$(18,205);CHR$(188);
4070 COLOR 15,0:LOCATE 8,20:PRINT"Start Frequency:";
4080 LOCATE 10,20:PRINT"Stop Frequency:";
4090 LOCATE 12,20:PRINT"Sweep Increment:";
4100 LOCATE 14,20:PRINT"Current Frequency:";
4110 COLOR 7,0:RETURN
5000 LOCATE 20,60: PRINT"Too High!  ";: 'Exceeds DDS limit...
5010 COLOR 7,0:FOR N=1 TO 5000: NEXT N: RETURN: 'Small delay...
```

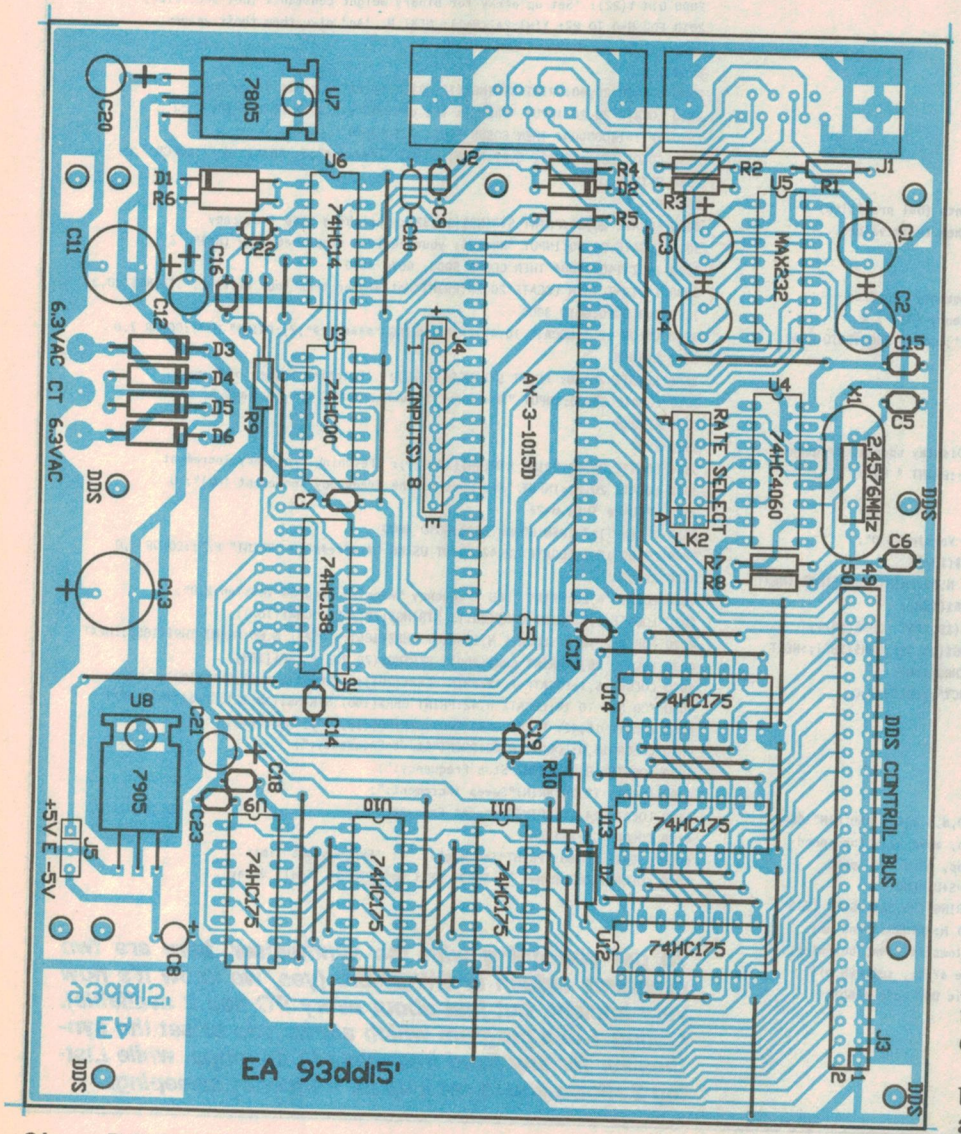
To get you going with the synthesiser, here are two programs written in GW-BASIC (yes, we know it's now very ancient, but just about every PC has it available). Listing 1 is a program which allows you to set the synthesiser for any fixed frequency in its range, while Listing 2 allows you to set it up for frequency sweeping.

links first (in this case there are quite a few — 35, to be exact). Note that where a number of links are run in close parallel, it's a good idea to run them in insulated rather than bare tinned copper wire.

Follow then by fitting the various connectors that mount on the PCB (J1, J2, J3, J5 and the baud rate selector header strip LK2). J5 is a 3-way 90° SIL header or 'launcher', to allow the use of a neat power lead between the interface board and the DDS3 module. Note that J4 is the optional 10-way data input connector, and would only need to be fitted if you're going to use the interface for another application.



Use these two overlay diagrams as a guide in placing all of the components on the synthesiser interface's main board and attenuator board. Note that the main board has spaces for crystals of two common sizes.



By the way, there are a couple of different brands of 90°-mounting DB9 connector currently available from local suppliers, and these differ significantly in the location of their connection pins relative to the two locating lugs or mounting holes.

The PCB has been designed to take the type which has the mounting lugs or holes on an axis midway between the two rows of connector pins. It is not really compatible with the other type, which has the mounting holes on an axis about 8mm further towards the front of the connector. It's also a good idea at this stage to fit the three PCB pins used to connect the low-voltage AC power from the transformer. These go near the edge of the board, just near the four rectifier diodes D3-D6.

Next fit the resistors, most of which have the usual 0.5" lead centres; the only exception is R9, which has its leads bent somewhat longer. Then fit the small ceramic and monolithic capacitors, followed by the solid tantalum and electrolytic caps and finally the signal and rectifier diodes. Use the overlay diagram as a guide to fitting the polarised parts with the correct orientation.

With these all fitted you can fit the two regulator chips U7 and U8, both of which mount horizontally on the top of the board. The 7905 negative regulator mounts directly, but the 7805 positive regulator is fitted with a small U-shaped finned heatsink to assist its heat dissipation. Both are fastened to the board with 3mm x 6mm machine screws and nuts, as well as having their pins soldered to the appropriate pads after bending down at 90° so they pass through the holes provided.

The final step in board assembly is to fit the 2.4576MHz crystal (which can be of either case size commonly available), and then the rest of the IC's.

I'd suggest using a 40-way DIL socket for mounting the UART chip (U1) to the PCB, as it's a relatively sensitive NMOS device. The remaining devices are either HCMOS or bipolar, and can be soldered directly into the board without undue risk. Just take the usual precautions — an earthed iron, and soldering each chip's supply pins first to allow the internal protection diodes to function. And fit them to the PCB the correct way around, of course!

Your main interface PCB should now be complete, although you may like to add the mounting pillars ready for the

DDS3 board before you put the board aside for a while. The attenuator assembly can be put together next, and here I suggest that you fit the PCB to the rotary switch before fitting the resistors or PCB pins. This is because mating the switch lugs with the PCB holes can be a little tricky, and is easier done when the board has no components. Note that if you have obtained a switch with extended 'solder loop' lugs instead of PCB tails, you'll have to cut the loops off with side cutters and possibly trim them slightly before they will mate with the PCB holes.

Once the PCB and switch are mated and the leads soldered to their pads, it would be a good idea to cut the switch shaft to about 10mm free length, ready to take your chosen control knob. You may also wish to file a suitable flat on the shaft, to allow a good purchase by the knob's attachment grubscrew — but bear in mind that the attenuator assembly actually fits in the case *upside down*. That is, with resistor R1 below the switch and the switch shaft axis just below the PCB/front panel centre line, rather than above it. It's the corner of the board nearest to R2 and R3 which may need a small section removed (approximately 4mm square), to clear the main interface PCB. You may wish to do this now, just in case.

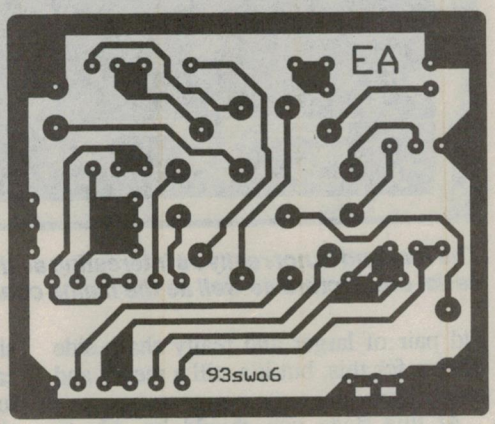
To complete the attenuator it's then just a matter of fitting the 21 resistors to the PCB, and also fitting four PCB pins to facilitate the input and output connections. Note that in this case the PCB pins are mounted from the *copper* side, not the component side.

With the attenuator complete, it too can be placed aside while you prepare the transformer mounting plate and bolt the transformer to it. Use 4mm x 12mm bolts, fitted with their heads under the plate and flat washers, star lockwashers and nuts above the transformer mounting lugs. Once these bolts and nuts are securely tightened, fit a second lockwasher, solder lug and nut on one of them, ready for the earthing wire. The correct bolt to fit with the solder lug is the one that is at 'six o'clock', when you're looking at the top of the transformer with the *mains connection* side of it facing to your right.

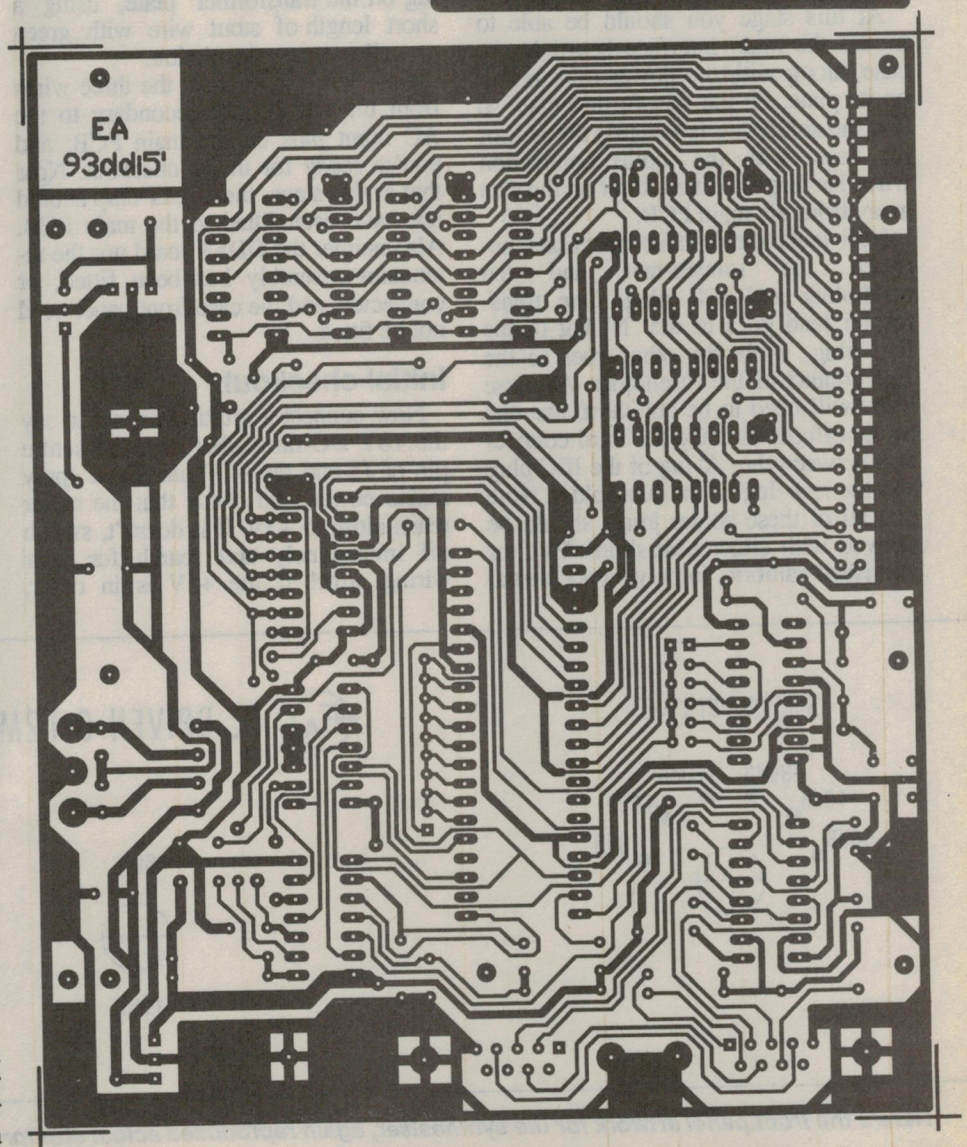
The next step is to prepare the case. As you can see, there are only three holes in the front panel — one for the attenuator switch and the other two for the BNC output connectors.

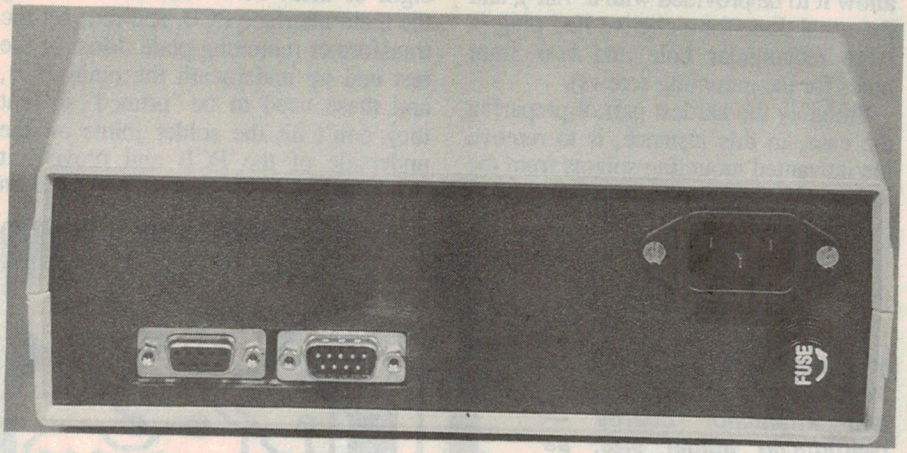
On the other hand the rear panel has a total of five holes, and involves rather more work. There's a long rectangular hole to clear the two DB-9 connectors, a round one for the mains fuseholder (ideally filed from a smaller size, to allow it to be provided with a 'flat'), and the usual three for a captive IEC plug (a large rectangular hole and two 3mm holes for the mounting screws).

Probably the hardest part of preparing the case, in this instance, is to remove the unwanted mounting spigots from the lower half of the case itself. This type of case provides a large number of spigots, for flexibility, and we really only need eight of them here: four for mounting the main interface PCB, and four for the transformer mounting plate. Most of the rest end up underneath the main PCB, and these need to be 'pruned' so that they don't hit the solder joints on the underside of the PCB and prevent it from being mounted properly. I used an



You guessed it. These are the PCB patterns for the interface and attenuator boards — reproduced actual size, as usual to allow you to make your own boards easily.





The rear end is not really as interesting as the front, but does include the RS-232C serial connectors as well as the mains connector and fuse holder.

old pair of larger and really sharp side cutters for this, but it's still a messy and tedious job.

At this stage you should be able to mount the main interface board in the case, along with the power transformer on its plate. Fit the transformer plate so that the solder lug is towards the rear of the case, with the mains connection wires leaving the transformer on the side away from the main PCB.

Now make the mains connections, between the transformer and the fuseholder and IEC plug. One transformer lead goes to the 'N' lug of the IEC plug, while the other goes to the *side* contact of the fuseholder. As these leads will need to be cut short, use one of the offcuts to make the third connection between the 'A' lug of the IEC plug and the *rear* lug of the fuseholder. Note that all of these solder joints should be sleeved with either heat-shrink PVC or varnished cambric, to prevent accidental shocks. Don't forget to connect the earth lug of the IEC plug to the solder lug on the transformer plate, using a short length of stout wire with green or yellow/green insulation.

Now you can connect the three wires from the transformer secondary to the AC input pins on the main PCB, and you're ready for initial checkout. Note that at this stage, the UART chip should not have been fitted to the main PCB. Also neither the DDS3 board nor the attenuator assembly has been fitted, or connected, and the case front panel need not be fitted.

Initial checkout

Now connect a multimeter, set to say the 10V DC range, between the centre pin of J5 and the +5V pin. Then apply mains power, and check that the meter reads close to +5V. If it doesn't, switch off immediately and search for your wiring error! If the +5V is in order, check that -5V is also present, on the third pin of J5. Then check that -10V is present at pin 2 of U5, and the adjacent ends of R1, R2 and R3.

If you have an oscilloscope, you can check that the crystal oscillator is working by probing pin 9 of U4. This should reveal a healthy 2.4576MHz square wave, and the row of LK2 pins nearer U4 should provide 153.6kHz, 76.8kHz, 38.4kHz, 19.2kHz, 9.6kHz and 4.8kHz respectively (16 times the corresponding bps rates).

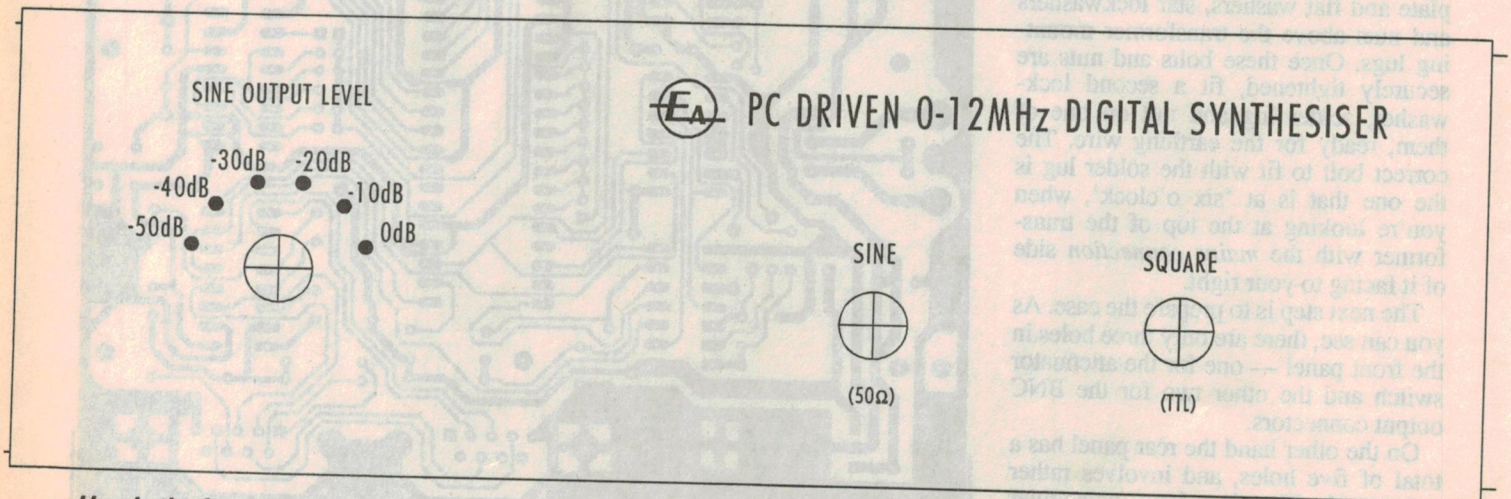
Note that if all seems well so far and you haven't as yet fitted the jumper shunt for LK2, this can now be fitted. For the default speed of 9600bps, it should be fitted in the 'A' position, at the end nearer R7.

Assuming everything has checked out correctly this far, switch off the power and carefully insert the UART chip U1 into its socket. Your interface card is now complete, and you should be ready for the final stage of assembly.

If you haven't already made up a 50-way interconnecting cable to run between the J3 header and the corresponding header on the DDS3 board, now is the time to do so. It can be quite short — only about 45mm long (plus 30mm to allow for the strain-relief loops). After cutting a piece of 50-way ribbon cable to this total length, carefully crimp on an IDC connector at each end using a small vice. Then loop the cable and fit the outer clamps.

You'll also need to make up a short three-way cable, to supply the DDS3 board with power from the interface card's J5 launcher. This cable is best made from a three-wire piece of rainbow ribbon cable, again about 75mm long, and fitted with matching three-way SIL connectors at each end.

Three further internal cables are



Here's the front panel artwork for the synthesiser, again reproduced actual size for your convenience.

needed, each cut from light duty 50-ohm coax. Two of these have two-way SIL connectors fitted at one end, to run from the sine and square outputs of the DDS3 board to the attenuator input pins and squarewave output connectors respectively. The third is to run from the attenuator output to the sinewave output connector, and solders directly to each.

Final assembly

With each of these interconnecting leads made, you're ready to begin the final assembly. First mount the attenuator and the two output connectors on the front panel, and then fit the front panel into the case. This will allow you to fit the cables to the output connectors, before the DDS3 board is fitted.

One cable runs from the sinewave output connector to the output pins of the attenuator, while the other connects to the squarewave output and ends in a two-way SIL connector.

The remaining coax cable can be connected to the attenuator input pins, at this stage, ready to connect to the DDS3 sinewave output pins. Now you should be able to fit one end of the 50-way and three-way cables to J3 and J5 of the interface board, respectively, ready for the next step of mounting the DDS3 board on the pillars. And with this done, you can connect the 'top ends' of the two cables, to complete things. Just remember to take special care with the three-way power cable — don't twist it, or the power to the DDS3 could be reversed in polarity, with disastrous results!

Your synthesiser should now be functionally complete, and ready for final checkout. There's just one final thing to make sure of, at this stage: that all of the manual programming DIP switches on the DDS3 board are set to OFF, with their sliders towards to SIL resistor networks and away from the 50-way connector P1.

Final checkout, use

You should now be able to connect up the synthesiser to your PC, via a suitable serial RS-232C cable. This will need a DB-9 connector at one end to mate with J1 on the interface, and either a DB-9 or DB-25 connector at the other to suit the computer's serial port.

Then you can connect an oscilloscope to the sinewave output of the synthesiser, and perhaps a counter to the squarewave output to monitor the frequency. The attenuator should be set to the fully clockwise position, to give maximum sinewave output.

When you apply power to the interface and the PC, there should be no output from the synthesiser initially because the interface latches are all reset and programming the DDS3 for an output of 0Hz. You'll have to send a string of six data bytes to the interface, before an output will be produced.

The easiest way of doing this is probably to run the GWBASIC program shown in listing 1. This is my third revision of a simple frequency setting program for the synthesiser, and should work on virtually any IBM-compatible. It simply sets up the COM1: port for 9600bps, and then asks you to input the desired frequency in Hertz. When you do this it converts your decimal frequency figure into a 23-bit pure binary number, splits this into six nibbles, and sends them off to the synthesiser. It then displays your 'Current output frequency' on the screen, and waits for you to input another frequency.

You'll find a fair number of comments in the listing, to help you figure out how it works. Note that if you want to use a different serial port from COM1:, or a different baud rate, you'll need to change the content of the OPEN statement in line 10.

As well as letting you try out your synthesiser, this same program can be used to program it for producing any desired frequency in its 2Hz - 12MHz range. (Actually the program will let you take the DDS3 up to 14MHz, but stops you going beyond this point.)

If you'd like to experiment with using the synthesiser for sweeping, listing 2 gives you another simple GWBASIC program to get you going. It lets you input the sweep start and stop frequencies, the frequency increment (2Hz minimum) and the number of sweeps. These are all displayed on the screen, and then it takes over and sends the stream of data to the synthesiser, to make it all happen.

How fast the sweeping takes place will depend largely on the clock speed of your PC. On a typical 286 machine running at 12MHz, I obtained sweep speeds of 22 frequency increments per second; while a 386SX running at 20MHz gave 33 increments per second.

Faster sweeping

While these sweep rates are probably OK for audio sweeping, if you use a little judicious selection of the frequency increment, they're rather too slow for IF

PARTS LIST

Main interface

Capacitors

C1-4	22uF 16VW RB electrolytic
C5	33pF NPO ceramic
C6	82pF NPO ceramic
C7,9,14,15,17-19,22,23	0.1uF monolithic
C8,12,20,21	2.2uF 25VW solid tantalum
C10	180pF ceramic
C11,13	2200uF 16VW RB electrolytic
C16,22	100pF ceramic

Resistors

All 1/4W 5%:

R1-3	5.6k
R4	100k
R5,10	10k
R6,9	2.2k
R7	10M
R8	1k

Semiconductors

D1,2,7	1N4148 or similar sig. diode
D3-6	1N4001 or similar rectifier
U1	AY-3-1015D UART
U2	74HC138 three-bit decoder
U3	74HC00 quad gate
U4	74HC4060 osc/divider
U5	MAX232 or TSC232 serial interface
U6	74HC14 hex Schmitt inverter
U7	7805 +5V TO-220 regulator
U8	7905 -5V TO-220 regulator
U9-14	74HC175 quad latch

Miscellaneous

J1	DB-9 connector, female 90° PCB mounting (see text)
J2	DB-9 connector, male 90° PCB mounting (see text)
J3	50-way DIL pin header
J5	3-way SIL pin header, 90°
LK2	12-way DIL pin header
X1	2.4576MHz crystal
T1	Power transformer, 12.6V CT at 1A
P1	Captive IEC mains plug, panel mount
F1	Mains fuse holder, 500mA cartridge fuse

Plastic instrument case, 200 x 160 x 65/70mm; PC board 144 x 118mm, coded 93ddi5'; small TO-220 heatsink; 2 x BNC sockets, single-hole panel mounting; 2 x 50-way DIL connectors, IDC type; 75mm length of 50-way ribbon cable; 2 x 3-way SIL connectors; 75mm length of 3-way rainbow ribbon cable; 2 x 2-way SIL connectors; 3 x 160mm lengths of light duty 50-ohm coaxial cable; 4 x 25mm tapped spacers with screws and lockwashers; 3 x PCB terminal pins; 100 x 40mm piece of 1mm aluminium sheet; solder lug; 4 x 3mm x 12mm machine screws with nuts and star lockwashers; hookup wire, etc.

Attenuator

Resistors

All 1/4W 1%, unless specified:

R1,2	27 ohms
R3	36 ohms
R4,5	39 ohms
R6,8-10	10 ohms
R7,11	47 ohms
R12,15	120 ohms
R13,16	82 ohms
R14,18-20	1 ohm (may be 1/2W 5%)
R17,21	51 ohms

Miscellaneous

SW1	2 pole 6 position rotary switch

PC board, 59 x 50mm, code 93swa6; 4 x PCB terminal pins; small control knob

or RF sweeping. However there are a number of ways you could speed things up — don't forget that the DDS3 synthesiser board itself can change frequency *very* much faster than this. The problem is one of getting the 23-bit frequency data words to it, at a fast enough rate...

The first method of speeding up the sweep rate would be to replace my simple GWBASIC programs, with software capable of processing data faster. You could try programs written in C, perhaps, or even in assembler if you're experienced in it. One of the newer compiled BASICs like Microsoft's Visual BASIC might well be capable of doing the job too, I suspect, and I hope to try this soon myself.

With faster software, you'll be able to get the sweeping rate up to the next limit — which is imposed by the serial interface. At 9600bps, this will limit us to around 960 data nibbles per second, or 160 (i.e., 960/6) frequency increments/second.

Of course the PC's serial port can run faster than 9600bps; most will run to at least 19,200bps, while some will go as high as 115,200bps.

However the readily available AY-3-1015D UART used in our interface will only run to about 30,000bps, so in practice our upper limit is probably going to be 19,200bps — corresponding to about 320 frequency increments per second. This might well be sufficient for many simple sweeping applications, however — especially if you use a digital storage scope for storing the response of the circuit being swept.

But how can you make the synthesiser interface operate at 19,200bps, when the present highest speed is 9600? It's a little messy, because the 74HC4060 chip used for generating the UART clock signals doesn't have the outputs from its earlier divider stages brought out to pins.

This means that you'll need to add an additional chip — say a 74HC393 binary divider, connected as a /8 frequency divider with its input fed from the 2.4576MHz crystal frequency available from pin 9 of U4. The resulting 307,200Hz signal could then be fed to LK2 in place of one of the existing signals, to provide the right UART clock for 19,200bps.

You could mount the additional chip on a small piece of perforated PCB stripboard, and connect it into the main interface via a four-way ribbon cable.

If you need to have the synthesiser capable of sweeping much faster than 320 increments per second, you'll really need to provide it with a different type of interface altogether. You could try using a dedicated Centronics parallel port, which will typically run at around 1000-3000 bytes per second depending upon the speed of the computer.

Using a different addressing system, say with six data bits and two address bits per byte, you'd perhaps be able to achieve 750 frequency increments per second using a fast machine.

But for faster sweep rates than this, you'll probably need to go to a custom interface card providing a latched 24-bit output, fed directly from the main CPU.

Hopefully the simple interface and software given in this article will at least get you off to a good start with your digital synthesiser, though. I hope you find it as interesting and enjoyable as I have! ❖

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READER INFO NO. 14

EDITOR'S NOTE: Novatech DDS3 kit availability

For those who may have missed the article in the April 1993 issue reviewing the Novatech DDS3 12MHz Synthesiser Kit, the kit is available from:

Novatech Instruments,
1530 Eastlake Avenue E., Suite 303,
Seattle, Washington 98102, USA.

The price of the kit is US$119.95 plus US$10 for handling and shipping, giving a total of US$129.95. Novatech prefers payment in US currency, but it will accept a bank cheque in Australian currency for the corresponding amount (currently about A$200.00).

NEW KITS FOR EA PROJECTS

Jaycar Electronics has advised us of its release of a new kit for the following recent *EA* project:

LOW COST NOISE & DISTORTION METER (May/June 1993): The Jaycar kit is complete as described, with all specified components. All resistors are of 1% tolerance, and the capacitors are of the compact MKT type. The front panel has an anodised gold finish, giving a distinctive appearance. The kit has the catalog number KA-1751 and is priced at $139.50.

Dick Smith Electronics has also advised us of its release of a new kit for the following recent *EA* project:

LOW COST NOISE & DISTORTION METER (May/June 1993): The Dick Smith Electronics kit is complete as described, with all specified components, all PC boards (including shielding boards), pre-punched and silk-screened front panel, pre-punched rear panel, meter and meter scale. The kit has the catalog number K-7222 and is priced at $129.00.

NOTE: This information is published in good faith, from information supplied by the firm or firms concerned, as a service to our readers. Electronics Australia cannot accept responsibility for errors or omissions.

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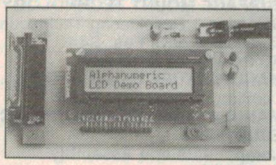
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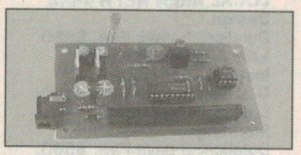


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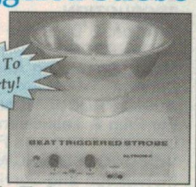
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Beat Triggered Strobe Kit

Add Some Life To Your Next Party!



(AEM July '85) Designed by Australian Electronics Monthly. Flashes in time to your music. Will also work as normal strobe. Exclusively customised by Altronics into our H 0480 Instrument Case, making construction a breeze and improving stability, safety and overall appearance. Includes silk screened panel. Two tube option available which boosts lighting output.

K 5790 Strobe Kit NORMALLY $79.95
This Month Only $70.00
K 5795 Two Tube Option **$16.50**

Low Cost Noise and Distortion Meter Kit

If you design, service, or experiment with audio equipment, this new instrument will fill a gap in your range of test gear. It can measure distortion levels down to less than 0.01% at spot frequencies of 100Hz, 1KHz and 10KHz, as well as providing a built-in low distortion oscillator and AC millivoltmeter. Best of all, it costs a fraction of commercial equivalents!



An Obsolute Must for Serious Hobbyists & Technicians

NEW

K 2542 **$137.95**

50 Mhz Frequency Counter Kit

EA Feb '93. This frequency counter kit offers high performance with out a high price tag. Features include an accurate 4 digit LED display, 5 ranges (10kHz, 100kHz, 1MHz, 10MHz, 50MHz) and a BNC input connector.

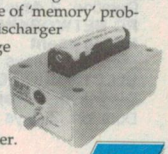


NEW

K 2512 **$89.95**

Single Cell Ni-Cad Discharger Kit

SC May '93. Do you have problems with nicads that are not performing to their maximum capacity because of 'memory' problems. This low cost discharger will correctly discharge any size single nicad cell so that it can be recharged to full capacity. Supplied with a single AA holder.

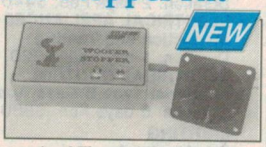


NEW

K 1642 **$27.95**

Woofer Stopper Kit

SC May '93. Do you have a noise pollution of the canine variety? Then bark back with this great kit. Simple push button operation emits a harmless 20kHz signal (beyond human hearing) which irritates the dog and in most cases takes out the temptation for barking.



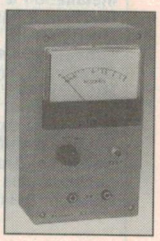
NEW

Stop that annoying Midnight Bark

K 1165 **$59.95**

Megger Meter Kit

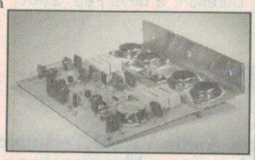
This design of an electronic meg-ohm meter features a dual voltage of 500 and 1000V with a large scale meter. It can resolve resistance from 1M to 200M ohm which is ideal for insulation testing.



K 2555 NORMALLY $79.00
This Month Only $75.00

Amplifier Module Kit Clearance

We have a quantity of discontinued amplifier modules which we need to clear to make way for new stock. Both modules come complete with all components (excluding power supply) to build high power amps. Includes heatsink and heatsink bracket. Not available from Altronic Dealers.



K 5140 100W into 4 ohms, NORMALLY $69.00, **This Month $50.00**

K 5150 150W into 4 ohms NORMALLY $99.00, **This Month $69.00**

Auto Power Switch Master/Slave Kit

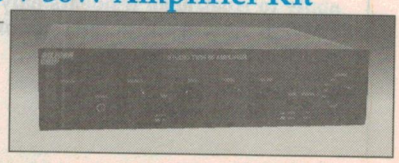
Simply plug in your amplifier the CD, tuner, tape deck etc. and each time you turn on the amp all the others automatically power up. Also great for computers and printers or videos and TV



K 6070 **$59.95**

Compact Stereo 50 + 50W Amplifier Kit

This fantastic new amp has all the features of commercial units costing hundreds of dollars more. Using TIP 142/147 transistors it is capable of producing a total of 47 Watts per channel RMS into 8 ohms. Features 6 inputs, bass, treble and balance controls, headphone jack, tone deafeat switch etc etc. Incorporates polyswitch protection.

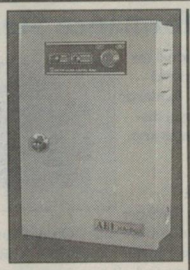


K 5045 **$299.00**

PHONE ORDER - FREECALL 008 999 007

Protect your Home or Business from Intruders With One of These "State of the Art" Burglar Alarm Security Systems

Economy 3 Sector Alarm Panel



Features:
• 3 Independent Protection Sectors • All Sectors are Compatible with N.O. and N.C. Switches • All Sectors are Sealed with End of Line Resistors • Adjustable Timers for Entry Delay and Siren Duration • Built-in Siren Driver • Output Relay is Selectable for 'Latch' or 'Timing' Operation • Remote Arming and Disarming Control Possible • Remote and Local Alarm Status Indication • Key operated arm and disarm • Requires 16 Volts AC M 9025 Plugpack, and Battery Backup S 5065-7 (Not Supplied)

S 5480 Normally $159.00,
This Month Only $147.50

Ideal for Homes & Small Commercial Premises!

Slider Pots



Hurry limited stock. 50kΩ. Ideal for replacement or new mixers, amps etc.

R 2090 **Only $1.00**

Dual Gang Pots

These dual gang, 100kΩ logarithmic pots include a centre notch making them ideal for balance, tone controls etc. Stocks limited.

Only $1.50

Sorry Not Available from Altronic Dealers

Gell Cell Charger

Charging current 300mA at 12V. Includes red and black colour coded spade terminals for easy connection to most gel cell batteries.



Ideally Suits Lead Acid Batteries Opposite

M 8020 **$12.50**

12V Lead Acid Backup Batteries

Premium grade long life. Sealed lead acid batteries. Ideally suited for security alarm panels. Dimensions listed in mm and height does not include connection tabs.



S 5065	1.2AH	$29.95	42W	50H	96L
S 5067	3AH	$44.95	67W	60H	132L
S 5069	4AH	$49.95	68W	100H	90L
S 5070	6.5AH	$54.95	65W	100H	90L

Aviation Headset

1000's Sold Across Australia - Includes 2 Year Warranty!



It was not to long ago when spending $450.00 on an Aviation Headset was not uncommon. Altronics changed all that when we released our C 9070 Aviation Headset for under $189.00. Now with the edition of the flexible boom unit and helicopter version (fitted with a Nato plug) our headsets have gone from strength to strength. Add to this enhanced microphone, improved lead shielding and headband comfort these headsets must be the best value for money in Australia!

C 9070 Standard Model **$189.00**

C 9073 New Flexible Boom Model **$225.00**

C 9072 New Helicopter Model **$249.00**

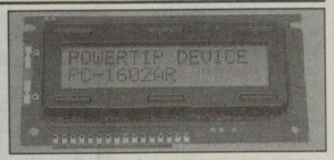
Aviation Push-to-Talk Switches



Includes quality velcro strap and simple push-button operation.

C 9090 **$29.95**

Alphanumeric Dot Matrix LCD Module



This compact LCD module has 96 inbuilt ASCII characters and 92 special letters which can be displayed on a 16 character by 2 line screen. The module will hold the current input on the display using its own built in memory, thus making it very easy to drive. Some possible applications could be within fax machines, measuring instruments, telephone applications or any other area where machine user feedback is required.

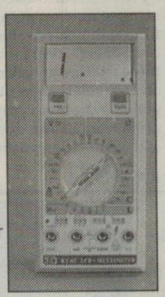
Z 7299 **$35.00**

Z 7309 Backlit Model **$56.95**

This Module can be Programmed for Personalised Messages
N.B. Requires Micro-Processor Driver

Digital Multimeter & LCR Meter

This digital meter tests in addition to standard multimeter ranges, capacitance and inductance, enabling you to test a wide variety of components. Indispensable for the design engineer, technician and enthusiast alike.



Q 1062 **$149.00**

Includes Carry Case

Universal Multimeter Carry Case Q 1052



Excellent padded vinyl case with zipper. Suitable for all meters advertised this month.

Free With Each Multimeter Ordered this Month

Weather Proof Sound Monitors and Sound Columns



Ideal for Hi-Fi extension, surround sound or outdoor use.

Features: • Rugged extruded aluminium construction • Superb black or white industrial grade powder coat paint finish • Engineer designed in Australia • Excellent reproduction • Superior to imports - yet a fraction of the price • All exterior fixings marine grade stainless steel • Speaker cones treated with special formula to repel moisture

Ideal for Surround Sound!

16 ohm 10 Watt

C 0938 White **$115.00** each
C 0940 Black **$220.00** per pair

8 ohm 20 Watt

C 0944 White **$149.00** each
C 0943 Black **$280.00** per pair

24 Range Digital Multimeter

Features 1% Accuracy and Massive 20A Current Check. 3.5 digit. Ranges include AC & DC voltage, AC & DC current, resistance, diode check, transistor check etc. this meter would have to be one of the best value multimeters available today.



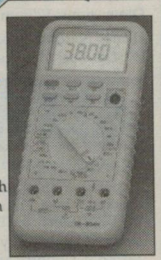
Q 1030 **$99.00**

New

Q 1040 Protective Holster to Suit $15.95

24 Range Digital Multimeter

With Frequency Measurement and Capacitance Meter. Includes frequency and capacitance ranges. With the addition of a built in logic probe and screen hold button it would have to one of the most useful DMM's available today.



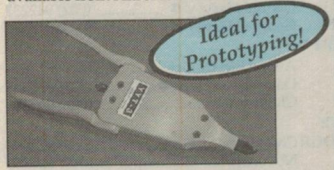
Q 1035 **$169.00**

Q 1040 Protective Holster to Suit $15.95

New

Cut and Clinch Tool

A neat tool which cuts, clinches and burnishes component legs in one stroke. This action holds the component in place for soldering allowing a quicker and easier solder joint. Burnish action improves solder wetting. Lightweight and comfortable. Rugged aluminium body. Durable mechanism. not available from Altronic Resellers.



Ideal for Prototyping!

T 2800 NORMALLY $35.00

This Month Only $17.50

Plug Packs

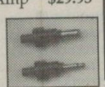
Our range of adaptors are each fitted with a 1.8M lead, in line socket and M 9014 2.5mm DC connector (different adaptor plugs available as below). Simple polarity setting. All energy authority approved.



Cat. No.	Output Voltage(s)	Max. Current	Price
M 9000	3, 4.5, 6, 7.5, 9, 12 DC	300mA	$19.95
M 9002	12V DC	300mA	$15.95
M 9004	9V DC	300mA	$15.95
M 9005	6, 9, 12V DC	500mA	$22.50
M 9022	12V DC	1A	$24.95
M 9027	16V AC	1.5 Amp	$29.95

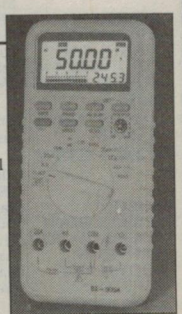
Adaptor Plugs to Suit

M 9013 2.1mm DC Plug $1.95
M 9014 2.5mm DC Plug $1.95
M 9015 3.5mm DC Plug $1.95



Auto Ranging 3.75 Digit Digital Multimeter

Triple LCD Display Includes 2 Digital & 1 Bar Graph. This incredible multimeter would have to be one of the most comprehensive on the market today. It is capable of doing all the normal voltage, current and resistance readings, as well as capacitance, frequency, minimum and maximum sampling, relating measurements, storing previous readings, limit setting, signal transistor gain checking and is full auto-ranging.



Q 1038 **$199.00**

New From ALTRONICS

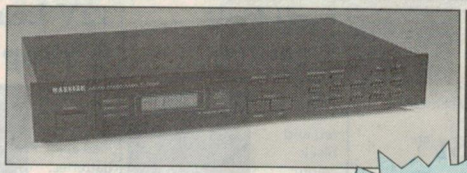
Q 1040 Protective Holster to Suit $15.95

ALTRONIC COMPONENTS

ALTRONIC COMPONENTS • Jet Express • AUSTRALIA WIDE

ALTRONIC COMPONENTS

AM-FM PLL Tuner



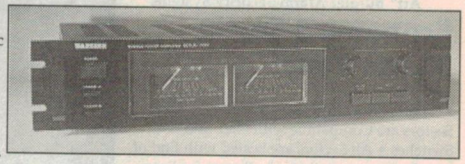
This fantastic tuner is the ideal add-on to any sound system. Can be used for background music in restaurants, shops etc. or for any P.A. application. Also a great upgrade for the home Hi-Fi.

Features:
• Digital LED frequency readout display • FET FM front end for high image rejection • Phase-linear ceramic filters are incorporated in both AM and FM IF section • Phase-lock loop (PLL) IC for FM multiplex stage

A 2210 NORMALLY $229.00 **This Month Only $199.00**

This Amp & Tuner Make an Ideal Combination

High Performance Stereo 90W Amp

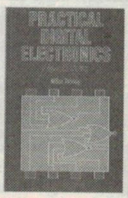


This stereo amp is ideal for background-foreground music applications. Fantastic for restaurants, shops, discos, PA sound systems and home.

Features:
• 90 watts RMS per channel minimum into 8 Ohms from 20 to 20,000 Hz with less than 0.05% THD • 2 large power meter indicators • XLR sockets for speaker terminals • Output relay to eliminate turn-on and off transients (de-thump)

A 2040 NORMALLY $625.00 **This Month Only $550.00**

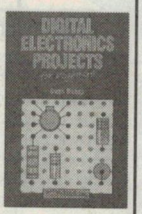
Practical Digital Electronics



By Mike Tooley. For those people interested in moving into the World of Digital Electronics, this book is an excellent introduction. It offers nine digital test projects to build which can be constructed on veroboard. As well as containing a range of CMOS and TTL data including some pinouts. Suitable for enthusiasts and students alike.

B 2260 **$16.70**

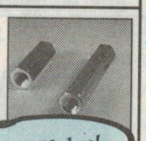
Digital Electronic Projects for Beginners



This is a great introduction to digital electronics with 12 electronic projects to build and experiment with. From huge security to instrumentation and 'fun' projects as well. All battery power full constructional details given.

B 2280 **$15.20**

Spacer Pack Clearance



We have a quantity of 4BA spacers and screws to suit. Not much use separately but together very useful. Each pack contains 100 25mm spacers and 200 10mm screws to suit. Very cheap hardware. Sorry not available from Altronic dealers.

Amazing Value!

Only $10.00 per pack

Electronic Projects for Guitars



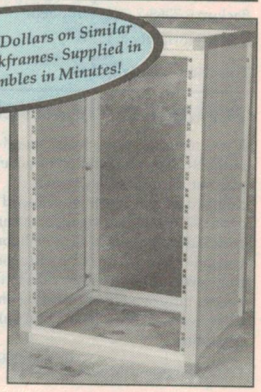
By RA Penfold. Make your own guitar effect pedals from commonly available component. Ideal for both those who are experienced and beginners alike. It's a collection of `16 guitar and general purpose effect units. Each project has an introduction, a circuit diagram and complete instructions.

B 2230 **$21.50**

Suitable for home or commercial use, these fantastic rack frames are durable, strong, good looking, light weight and easy to assemble.

Save Hundreds of Dollars on Similar Custom Made Rackframes. Supplied in Kit Form, Assembles in Minutes!

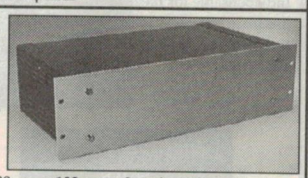
Professional Rack Frames and Panel Sets



The frames are available in either natural (nat) anodised aluminium or Black Powder Coat aluminium and the side panels are either Horizon Blue or Black Powder Coat finish. Ideal for use in home Hi-Fi systems, professional audio installations, Band Gigs, Computer patch panels etc.

H 5204	Rack frame 4U Nat	$139.00
H 5205	Panel set for H 5204	$49.00
H 5206	Rack frame 6U Nat	$149.00
H 5207	Panel set for H 5206	$55.00
H 5212	Rack frame 12U Nat	$169.00
H 5213	Panel set for H 5212	$89.00
H 5218	Rack frame 18U Nat	$189.00
H 5219	Panel set for H 5218	$110.00
H 5230	Rack frame 30U Nat	$229.00
H 5231	Panel set for H 5230	$159.00
H 5238	Rack frame 38U Nat	$269.00
H 5239	Panel set for H 5238	$195.00
H 5304	Rack frame 4U Black	$139.00
H 5305	Panel set for H 5304	$49.00
H 5306	Rack frame 6U Black	$149.00
H 5307	Panel set for H 5306	$55.00
H 5312	Rack frame 12U Black	$169.00
H 5313	Panel set for H 5312	$89.00
H 5318	Rack frame 18U Black	$189.00
H 5319	Panel set for H 5318	$110.00
H 5330	Rack frame 30U Black	$229.00
H 5331	Panel set for H 5330	$159.00
H 5338	Rack frame 38U Black	$269.00
H 5339	Panel set for H 5338	$195.00

High Energy Rack Case

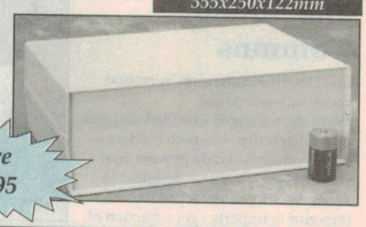


The use of heavy duty heatsinks as rack case sides now allows a myriad of amplifiers, power supplies, battery chargers etc, to be built in an "Off the Shelf" rack case. For very high heat dissipation this design allows the simple fitting of computer type fans to inside back of rear panel, adjacent to each respective heatsink. **Features:** • Uses Altronics H 0590 Heatsinks • Full Size 3 Unit Front Panel (480mm x 132mm x 3mm) • 1.0mm Steel Base, with Ventilation Slots • 1.0mm Steel Top Cover, with Ventilation Slots • Internal Dimensions: 125mm x 370mm x 250mm • External Dimensions: 130mm x 440mm x 252mm

H 0417 Natural Anodised Aluminium Front Panel
H 0418 Black Anodised Aluminium Front Panel
Both Normally $129.95, This Month $110

Super Large Instrument Cases

Massive 355x250x122mm



Designed to house amplifiers, inverters, power supplies micro-processor equipment etc. Built-in mounting posts for PCB's, transformers etc. Ventilated for efficient air-flow cooling. Extra tough, Super finish front and rear panels. Pictured battery for size comparison only.

H 0490 Case **$29.95**

Were $39.95

ALTRONICS

174 Roe St. Perth W.A. 6000
Phone (09) 328 1599, **Fax** (09) 328 4459
MAIL ORDERS C/- P.O. Box 8350
Stirling Street, PERTH W.A. 6849

STANDARD DELIVERY & PACKING CHARGE $3.50 to 500gms, $5.50 500gms -1 kg, $8 1kg-5kg **AUSTRALIA WIDE**-We process your order the day received and despatch via. Australia Post. Allow approx 9 days from day you post order to when you receive goods.

OVERNIGHT JETSERVICE Up to 3kg is $10.00, 3kg to 5kg is $23.00—We try to process your order the day received and despatch via. **Overnight Jetservice Courier** for delivery next day Country areas please allow additional 24-48 hours.

HEAVY HEAVY SERVICE-All orders of 10kgs or more must travel Express Road—Please allow 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs.

INSURANCE-As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require comprehensive insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance".

TOLL FREE PHONE ORDER-Bankcard, Visa, Mastercard Holders can phone order toll free up to 4pm Eastern Standard Time. Remember with our Overnight Jetservice we deliver next day.

ALTRONICS RESELLERS Chances are there is an Altronic Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ● These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

WA - COUNTRY

ALBANY — BP Electronics ● (098) 412681; Micro Electronics (098) 412077
BUNBURY — Micro Electronics (097) 216222
ESPERANCE — Esperance Comm. (090) 713344
MANDURAH — Forum Electronics (09) 5813466
PORT HEDLAND — Ivan Tomek Electronics (091) 732531
ROCKINGHAM — TV Joe's (09) 5271806

NT

ALICE SPRINGS — Farmer Electronics (089) 522388
DARWIN — Ventronics (089) 853 622

VIC - CITY

All Electronic Comp (03) 6623506
TECS (03) 6706474
BORONIA — Ray Cross Electronics ● (03) 7622422
CHELTENHAM — Talking Electronics (03) 5842386
COLLINGWOOD — Truscott Electronics ● (03) 4198208
CROYDON — Truscott Electronics ● (03) 7233860
FOOTSCRAY — G.B. Telespares (03) 3266035
PRESTON — Preston Electronics ● (03) 4840191

COUNTRY

BAIRNSDALE — LH & LM Crawford (051) 525677
BALLARAT — Ballarat Electronics (053) 311947
BENDIGO — Sumner Electronics (054) 431977
MILDURA — Pullman Auto (050) 232882
SHEPPARTON — Andrew Guyatt Elect. (058) 219497
WARRNAMBOOL — Koroit Electronics (055) 627 417

QLD - CITY

Delsound PL (07) 8396155
WEST END — B.A.S. Audiotronics (07) 8447566
WOODRIDGE — David Hall Elect.● (07) 8082777

COUNTRY

GLADSTONE — Gladstone Elect. Services (079) 724459; Electronic Enterprises (079) 726660
MAROOCHYDORE — Mals Electronics ● (074) 436119
TOWNSVILLE — Super Solex ● (077) 724466

SA - CITY

Force Electronics ● (08) 2125505
BRIGHTON — Force Electronics ● (08) 3770512
CHRISTIES BEACH — Force Electronics ● (08) 3823366
FINDON — Force Electronics ● (08) 3471188
HOLDEN HILL — Force Electronics ● (08) 2617088
LONSDALE — Force Electronics ● (08) 3260901
ENFIELD — Aztronics ● (08) 3496340

COUNTRY

WHYALLA — Eyre Electronics (086) 454764

TAS

HOBART — George Harvey ● (002) 342233
LAUNCESTON — George Harvey ● (003) 316533

NSW - CITY

A-One Electronics (02) 2674819
David Reid Elect. ● (02) 2671385
SMITHFIELD — Chantronics (02) 6097218

COUNTRY

COFFS HARBOUR — Coffs Habour Elect. (066) 525684
NEWCASTLE — Novocastrian Elect.Supplies (049) 621358
WARNERS BAY — Vilec Distributors (049) 566792
WINDSOR — M & E Elect. and Comm. (045) 775935
WOLLONGONG — Newtek Electronics ● (042) 271620
Vimcom Electronics (042) 284400
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New Project Boxes: both plastic & metal

Have you ever built a construction project, and then found that you need to mount it in a far too large jiffy box because it just doesn't fit in the next size down? Well, Jaycar has now come to the rescue with two new ranges, of six plastic and seven aluminium boxes, respectively — which greatly increases the variety of sizes available.

The sizes of the new plastic boxes range from a small unit suitable for housing a remote control transmitter to a large one which could be used for bench test equipment.

There are six sizes available in the new series, with the following dimensions (L x W x H): 90 x 50 x 16mm; 90 x 50 x 24mm; 120 x 60 x 30mm; 150 x 80 x 30mm; 190 x 100 x 40mm; and 190 x 100 x 80mm. Prices for the smallest to the largest box range from $2.95 to $13.95.

All cases are light grey in colour, and their top and bottom halves snap together. The two sections can also be joined more securely, using self-tapping screws into plastic pillars for the two smallest sizes, and bolts with corresponding brass inserts for all the larger ones. The front and rear panels — dark grey in colour — are both removable.

Inside the boxes, you can mount your PCB either vertically in the mounting slots provided, or horizontally by screwing the board to four moulded spacers. A set of spacers is available on both the top and bottom of each box.

These refinements mean that you don't have the added expense of buying mounting screws and pillars, and the necessity of drilling holes through the boxes to use them. The larger three cases also come with four self-adhesive rubber feet.

Sealed metal cases

The new range of die-cast aluminium boxes features a recessed neoprene gasket, with the wall mounting holes and lid fixing screws outside the sealed area, so that the enclosures are fully dust and water proof. The neoprene is also resistant to both oil and petrol, which further increases the boxes' usefulness.

The dimensions (L x W x H) for the seven boxes in this series are: 64 x 58 x 35mm; 115 x 65 x 30mm; 115 x 65 x 55mm; 115 x 90 x 55mm; 148 x 108 x 75mm; 171 x 121 x 55mm; and 222 x 146 x 55mm. Prices range from $6.95 to $29.95.

As in the plastic boxes, provision is made for either vertical or horizontal mounting of PCBs. In this case, pillars are only provided on the base of the enclosure, but the metal boxes include the four screws and washers to do the fixing.

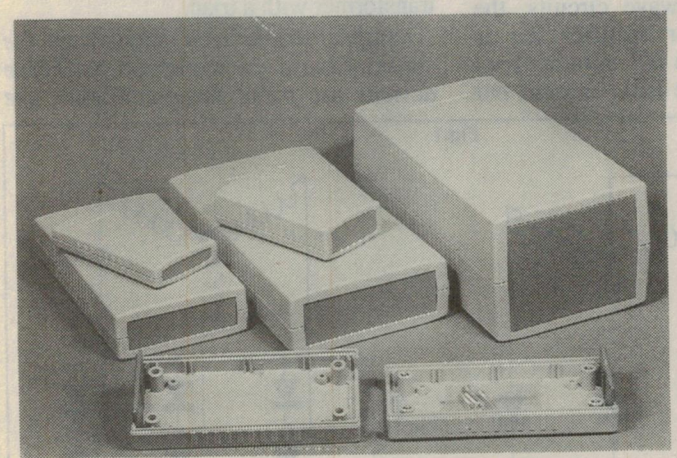
Summary

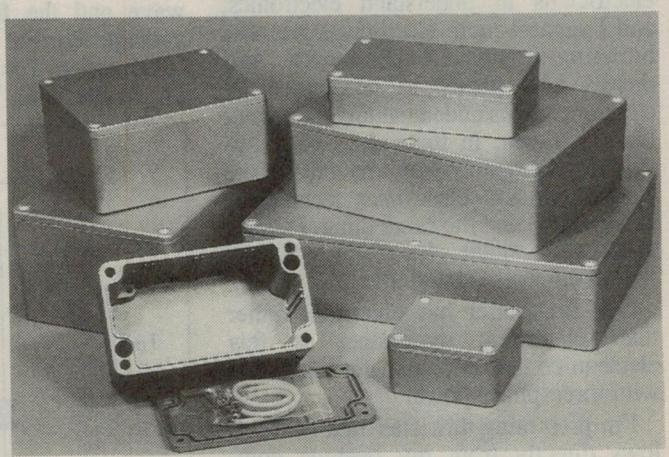
In appearance, the new high quality plastic boxes have a more professional finish than the traditional jiffy boxes, and their prices seem to be only slightly more than the older boxes. (It really is quite difficult to compare prices, because the dimensions of the new boxes are quite different to the old ones.)

And we found the new metal range to be of very solid construction with excellent sealing properties — ideally suited for projects mounted outside which must endure the ravages of the weather.

Both the plastic and metal enclosures are a welcome addition to the range of boxes available for housing construction projects, in their appearance, construction and variety of new sizes.

Full details for both series are listed in the 1993 Jaycar catalog (Cat. numbers HB6030-6038 and HB5030-5050, respectively), and all boxes are available from Jaycar outlets. (P.M.) ❖

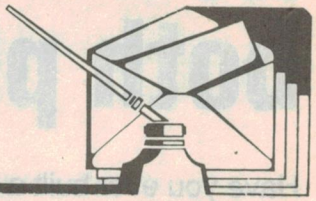




Left: Note the removable end panels and the moulded PCB mounting pillars in Jaycar's new range of plastic boxes. The variety of sizes will suit many construction projects. Right: These solid die-cast aluminium boxes include a neoprene gasket to ensure that they can be totally sealed against the elements. Wall mounting holes and lid fixing screws are kept outside the sealed area.



Information centre



Conducted by Peter Phillips

Three-phase rectifiers, boat speedo's and more

Component supply problems are raised by a vexed reader this month, and a few pertinent questions are asked about sound and computer equipment. There's also the usual range of questions, comments and useful information, along with a What?? question based on a simple transistor amplifier.

To the general public, an electrician is someone who knows about electricity, which means everything from house wiring to TV repair. An electronics technician is therefore, by default, an electrician, and the same applies in reverse. However, as most *EA* readers will know, there is a substantial difference between the two job roles. One definition (from an electrician of course) says that an electrician deals with 'real' currents, while an electronics technician works with 'leakage' currents.

Some people have both skills, and are equally at home with the SAA Wiring Rules as they are with a circuit diagram of a video recorder. But for the most part, the distinction between the two is ever present. As one who started life as an electrician, then moved to electronics after deciding it was cleaner and less strenuous, I relate to both sides.

These days there is a growing need for electricians to understand electronics, and I suspect more electricians are now browsing through *EA* occasionally. And there's also plenty to be gained by electronic types understanding the role of the electrician. In these days of multi-skilling, it probably won't be long before electricians and electronics technicians become one and the same thing. Perhaps then we might have to call it 'Electricalonics Australia'!

Our first letter has electrical rather than electronic overtones, as few electronics technicians get involved with three-phase power.

I'm presenting this letter first as it follows directly from my opening comments, but it's also worth noting that 12 months ago I devoted the entire column to single-phase power supplies. I'm able to answer this current letter by referral to the same data that supplied the information last year.

3-phase rectifiers

Pen is being put to paper in regards to rectifier currents — not the single-phase capacitor inputs etc that have recently starred in your column, rather three-phase.

I would like to know the formula for diode currents in a three-phase bridge, in a car alternator for example. It would be excellent if you had the formulae for both resistive load and capacitive load bridges. (J.O., Blackheath NSW).

There are various three-phase rectifier circuits, J.O., but the two most common are those shown in Fig.1. The primary of the three-phase transformer is not shown, and in the case of a car alternator it's not present anyway.

The 1964 Mullard data I'm referring to gives the following: for the half-wave and the full-wave circuits, the average current per rectifier leg is 0.33I, where I is the DC current flowing in the load. The RMS current per leg is 0.588I (half-wave) and 0.577I (full-wave). The peak current per leg is 1.21I (half-wave) and 1.05I (full-wave). There are three legs in the half-wave circuit and six in the full-wave circuit.

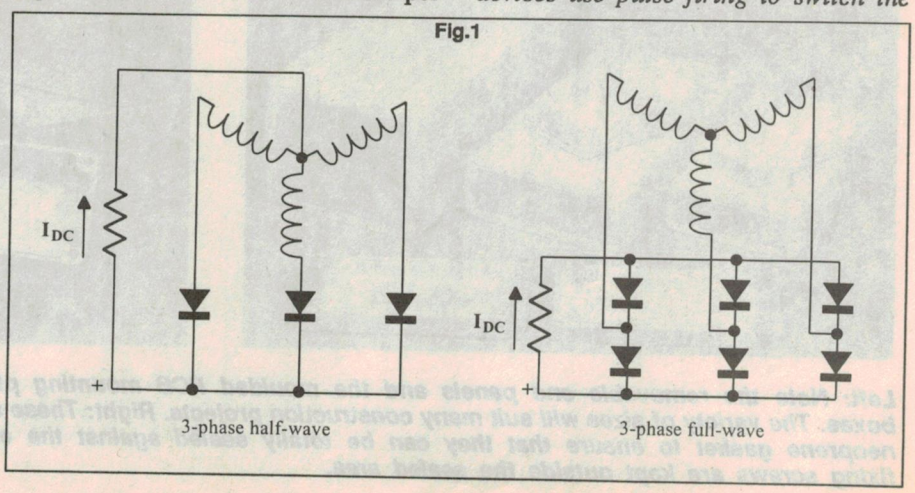
The Mullard data gives values for an inductive load, but not for a capacitive load. As with the single-phase circuits, adding a capacitor to a three-phase rectifier circuit complicates things, as the current is now coming in short bursts. The ripple frequency for both circuits is quite high: three times the supply frequency for the half-wave circuit, and six times for the full-wave circuit. Therefore, the effect of a capacitor is probably not as great as in the single-phase circuits, but it would still affect the current ratios I've given.

Triacs, transformers

Staying with power for a bit, here's another letter proving you *can* control a transformer with a triac.

I suspect simple lamp dimmers are the cause of burnt out transformers. These devices use pulse firing to switch the

Fig.1



triac and when the load is a transformer, there will be an inductive component present regardless of the secondary load conditions. The result can be marginal firing conditions where the pulse duration is inadequate to reach the triac holding current, causing a 'misfire'. Since a triac has different firing characteristics for different current directions, it's easy to see that this can result in conduction in a single direction. The resulting DC component will subsequently burn out the transformer.

The way to overcome this is to fire the triac during its full desired conduction period with a suitable DC current pulse; for small transformers a square wave is fine. dI/dt is normally not a problem with smaller transformers, as the winding resistance together with their 'spread' inductance usually provides adequate protection. Larger transformers with inadequate spread inductance might need a choke in series to prevent too large a transient occurring. Inspection with a CRO will show detrimental spikes or current rise times beyond the triac capabilities. dV/dt is suppressed in the usual way with a snubber network around the triac.

We have successfully used triac controllers based on these principles for many years to control transformer outputs and inputs as well as vibratory feeders, fans, motors and so on, with no adverse effects. Needless to say, the additional hardware tends to make these controllers a tad too large for domestic light dimmers. (T.B., Ermington, NSW).

Thanks T.B., you confirm the comments made in the May edition, where it was also pointed out that something better than a simple pulse is essential to ensure regular and symmetrical firing of the triac. So obviously it's quite practical to control a transformer with a triac, which neatly leads into our next letter...

QI lamp dimmer?

Ever wondered whether you can dim quartz iodine lamps?

I've recently installed recessed QI lamp fittings in a room designed for relaxation. The light colour from the installation is wonderful, but at times it's a bit too bright. I believe it's possible to dim these lights, but what sort of dimmer do I need? Or can I simply use a conventional light dimmer. (D.S., Newtown, NSW).

I suppose many readers have seen claims for dimmers that can handle transformers, such as those used with 12V QI lamp installations. And no doubt these dimmers are perfectly capable of handling such a load. But that's not the problem! The problem is, D.S., that you can't dim QI lamps unless you're prepared to replace the lamps every few weeks.

A QI lamp has to operate at a certain temperature, which can even mean some types of QI lamps have to be orientated correctly. If the operating temperature is reduced, as it would when dimmed, the filament burns out much more quickly. The reason is that a QI lamp operates on the basis that if the temperature around the filament is correct, all material boiled off the filament is returned and redeposited back on it. Lower the operating temperature and this recycling mechanism becomes ineffective — so the filament simply 'boils away'.

So unfortunately, despite claims to the contrary, QI lights are NOT designed to be dimmed.

Shielded speakers

About 12 months ago I myself was asking the same question posed by our next correspondent:

Could you please advise whether the speakers that are now advertised as being suitable for placement close to television sets have been specially designed to avoid interference with the television picture, or whether they are conventional speakers that have been shielded in some way.

I am interested in the process involved, in part as I have a number of excellent speakers which I want to use for surround sound. I also want to place them next to a television set and I would like to be able to provide some kind of magnetic shield. (H.P., Balwyn Vic).

Dolby Prologic surround sound needs a minimum of four speakers: left and right front, centre and one or two effect speakers. The centre speaker does most of the work, so it has to have a good quality sound. But this speaker usually has to share centre stage with the TV set, and because of magnetic interference, you can't put any old speaker near the TV set.

These days you can buy magnetically shielded speakers designed to fit under or on top of the TV set — but at a price! Like you, H.P., I wondered what the big deal was — surely it should be easy enough to shield a speaker box? However, my research reveals that it's not the box that's shielded, it's the actual speaker. That is, the speaker itself is a shielded unit, although otherwise conventional.

While this is probably not an expensive process, it does make the speaker rather special. I doubt if a conventional speaker can be effectively shielded to the same extent by a home handyman.

You might wonder about speakers used *inside* the TV set. Why don't they affect the picture? In fact they do, but judicious placement and choice of speaker minimises the effects. Most speakers fitted inside a TV set have tiddly little magnets that haven't the field strength to do much damage. But when you get a decent quality speaker, such as the centre speaker in a surround sound set up, you're dealing with a much more powerful magnet.

So, H.P., there is truth in the advertising, and I can assure you the magnetic shielding on the speakers I've seen is effective and their sound quality is excellent.

Guitar amps

The next letter wants information about new generation guitar amplifiers...

Since the mid-1980s a new generation of valve electric guitar amplifiers which feature 'high gain' (that is, high distortion), have become increasingly popular. In particular, recently developed amplifiers such as the Marshall JCM 900, Peavey 5150, Ampeg VL and the Soldano are now standard equipment among professional musicians. In terms of the sound (and I imagine also their design), these amps are fundamentally different to the electric guitar amplifiers that were produced in the 1960's and 70's.

I am interested in building a new style valve guitar amplifier, but I cannot find much information about them. Have you considered publishing an article about these 'new' amps to remove the mystique their designers and manufacturers seem happy to promote?

I think such an article would raise considerable interest, provided it is relevant to the contemporary music scene. From my experience, I conservatively estimate that at least 80% of electric guitarists use some form of valve amplification. Yet there's very little information about the design of the new generation types, especially in technical magazines like yours. (C.S., Carnegie Vic).

While I agree there are quite a lot of musicians using valve guitar amplifiers, I wonder how many of these would want to build them, repair them or even read about how they work. From my experience, professional musicians rarely get inside the equipment they use.

Nonetheless, I'm sure an article about 'new generation' amps would be of interest to many readers. The problem is, like you C.S., we don't know a great deal about how these amps differ from their

early counterparts. The term 'valve amplifier' is also a bit misleading, as often the only part that is valve is the output stage. All the rest is usually solid-state. I suspect that any changes to the design are in the solid-state section, and it's unlikely these changes are any more dramatic than changes in audio equipment in general.

For example, the use of audio digitising and digital signal processing (DSP) is probably now a part of these amplifiers, just as it is in up-market hifi gear. There may be additional effects, including a more controlled 'distortion' effect.

Anyway, I certainly don't claim much knowledge about these amplifiers, and I would be grateful if any readers can fill the gap. Perhaps as a result we might be able to prepare such an article.

Bitching corner

The cost and availability of parts is something we all come up against, so we might put aside a section each month to allow frustrated readers to air their complaints. Here's one that just arrived:

I was glancing through the December 1992 edition of EA and I read the article about the inductance adaptor (page 80). When I got to the parts list, the TL431 rang a bell.

A few weeks ago I tried to purchase one of these and rang every parts supplier in Melbourne. The only one which even knew about them was Radio Parts. Their fancy computer confirmed there was no equivalent. I then found a wholesaler in Bayswater who could get them. The problem was that while the cost of the component was about 35c, I had to have a $25 minimum order. Pity the young constructor! (R.H., Alphington, Vic).

Table 1

SG of acid	Volts per cell	Volts per 6 cells
1.150	1.989	11.93
1.175	2.012	12.07
1.200	2.035	12.21
1.225	2.058	12.35
1.250	2.081	12.49
1.275	2.104	12.62
1.300	2.126	12.76

I'm not sure, R.H., if your complaint is directed at us or at parts suppliers in general. From our point of view, this project was developed by a contributor who probably has a source of these otherwise seemingly hard to get devices.

If we can find a suitable source, we will let readers know. Otherwise, I'm sure many readers will empathise with your experience.

By the way, I notice that both Jaycar and Altronics are advertising a full kit for the Inductance Adaptor in their latest catalogs, so they may also be able to supply the device concerned.

Hidden remote keys

The April edition included an article about 'hidden' buttons on remote control units. Here's information on a few more:

Regarding hidden keys on remote controls, the JVC HRD 520 video remote control has a 'memory' key hidden. The AWA AV 51 video remote has 'Channel up and down', and it also has a button best described as 'Audio mute during playback.'

Incidentally, for anyone working on remote controls, an essential tool is a Uniden VM100 CCTV, which lets you see the pulses coming from the IR LEDs. (B.R., Nth Fitzroy, Vic).

Thanks B.R., perhaps other readers might like to add to the list of hidden buttons. Another way of 'seeing' the output of a remote control, or at least testing if there is one is with the simple IR Remote Tester described in September 1990.

Reference voltage

Here's a letter from a fairly regular contributor to these columns, this time about a do-it-yourself voltage standard:

Not many of us own or have access to a good voltage standard. I recently wanted to change the range on my multimeter to give a 0 - 25V range, the nearest ranges being 0 - 10 and 0 - 50V, with neither suitable for automotive use.

The meter had a 2000V range which I never use and a 0 - 250V range which had a suitable scale. So it was only a matter of changing the series resistor in the 2kV range for another. But where does one find a suitable reference voltage for calibration? What about a car battery?

I decided to dig out my 1941 copy of 'Chemical Engineers Handbook', which holds much useful data on electrochemistry and found a formula for determining the open-circuit voltage E of a lead-acid cell: $E = 1.850 + 0.917(G-g)$, where G is the specific gravity (SG) of the electrolyte and g is the specific gravity of water at the cell temperature.

Examining this formula shows that the corrections for SG and temperature are a fraction of the cell voltage (less than 20%) and therefore errors in measuring them will have reduced effects on the calculated value of E. Looking up the SG of water at room temperatures shows only a 0.3% variation from 16 to 29° so if 0.2% is used the error from this source becomes negligible at temperatures of say 20 to 25°C. The formula is then: $E = 1.850 + 0.917(G - 0.998)$.

Applying this formula to a range of SG's, assuming the battery has six cells and that their SG's are averaged, you get the voltages shown in Table 1. To use these voltages for calibration, a car battery should (a) be in good shape, with reasonably even cell SG's, (b) not have been used for a day or so and (c) not have been recently topped up with water. The effective SG is that obtained within the plates themselves, so enough time must be allowed for it to stabilise by diffusion (watch the voltmeter over a period). Even opening the car door

NOTES AND ERRATA

Noise & Distortion Meter (May 1993): The schematic diagram on page 64 shows D7 with the wrong polarity. The anode (+ve) terminal should connect to IC8.Also, there should be a 680 ohm resistor (R16) between the output of IC2 (pin 6) and the junction of R17 and RV5, rather than a direct short as shown. In both cases, the PCB and overlay diagram are correct.

Select-a-Chime (April 1993): It's possible that the tolerances of the timing components for IC2 (R20, R21 and C5) could require too high a control voltage setting on pin 5 (if their resultant value is too low), preventing RV2 adjusting the frequency down to 262Hz. And vice versa.

If the combined value of the three components is too small (with the frequency output too high), pad C5 with a capacitor, say 2.2nF. This will drop the control voltage required by about 0.1V. Conversely, if the value is too high (frequency too low), pad R20 with, say a 1M resistor, to increase the control voltage by about 0.1V. Also, on p.75 of the text (bottom of column two), it should read 'solder the cathode of diode D7 to output' (not D8).

causes a small battery discharge via the roof light.

Measure the SG of each cell with as good a hydrometer as possible, average them then look at the appropriate voltage for the whole battery. The final result should be no more than 1% in error.

The data is half a century old, but such things don't change much. I'd be interested to know if any of your readers get to actually check the voltages in Table 1 with a decent reference voltage. Perhaps someone has a later formula or standard. The formula may possibly be influenced by such things as the use of antimonial lead in battery plates. No mention is made of this in the handbook; perhaps it cancels out if positive and negative plates use the same alloy. (R.V., St Georges Basin, NSW).

Thanks R.V., for this useful information. Apart from giving a reference voltage it's also useful information in general about lead-acid batteries.

Electromagnetic log

The next letter is in response to a letter from the same correspondent R.V., presented in January. In case you can't remember back that far, R.V. proposed a simple design for a boat speedometer. His idea was based on the premise that 'if a conductor, in this case water, is moved through a magnetic field, an electric current will be generated in the water — a magneto-hydrodynamic generator.'

Since then I've received complete details of a speed and distance indicating device called an electromagnetic log, made by Yokogawa Hokushin Electric (YEW), Japan. The sender of this information has this to say...

Regarding the letter by R.V. in January, I enclose a copy of the handbook for the electromagnetic log fitted to the ship I sail on as Electrician/Electronics Officer. This log operates on the principles outlined by R.V. and has proved to be a superbly reliable unit, as is most of the other Japanese equipment on board. I can't supply schematics, as they aren't normally delivered with the equipment and are generally impossible to obtain, making repair work a bit of a problem at times. (C.D., Auckland, NZ).

As well as the info on the electromagnetic log, C.D. included information on the ship he sails on. Named the *M.V. Pacific Ataawhai*, the ship is a multi-function supply, firefighting, RIV, standby and dive support vessel, also built in Japan. It can accommodate 60 people, is 77m long and has a generator set rated at nearly 0.5MW. Not exactly a run-about!

Thanks for sending all this information C.D., and it seems R.V. has been beaten to the goal posts with his idea.

CD-ROM

The next letter asks a question I'm sure a few people have pondered...

I am keen to obtain a CD-ROM system, with sound-blaster/interface card and so on, but I discover the cost of the CD hardware is most prohibitive. In fact, a CD-ROM system is about three to four times that of its audio counterpart.

My question is — is there available, or likely to become available, an interface system so that a conventional CD music player could be used with the computer. With my understanding, the CD hardware (drive system and laser tracking) must essentially be the same with the two systems. (T.T., Papakura, NZ).

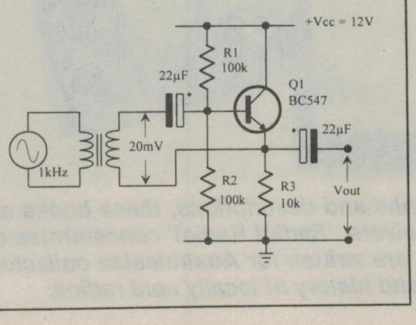
I haven't had time to do extensive research on the answer, but preliminary enquiries to those in the field suggest there is very little difference between a CD-ROM player and a conventional CD player. However, there are several differences, which on the surface may seem relatively minor but may still be significant in themselves. The first is that a CD-ROM player usually has two outputs: digital and analog. The digital output (probably taken off before the A-D converter), is fed to the computer over a multiway ribbon cable. Such an output is not usually available on a conventional CD player.

The other is the interface between the computer and the player. Rather than mechanical pushbuttons, functions like play, search and so on are invoked from the computer screen. This therefore means a different control system inside the CD-ROM player.

(*Editor's Note: My understanding is that CD-ROM players also incorporate much more extensive error checking and correcting logic, compared with audio CD players...*)

But one has to ask whether these differences are as costly to implement as suppliers would have us believe. Is this a case of charge what the market will pay? I think so. The problem is, could I (or any reader for that matter) adapt a conventional CD player to a CD-ROM system? I give in, but perhaps other readers have a few ideas. We've recently described a Teletext to computer interface, so how about an interface for a budget CD player! Certainly there seems to be no commercial interface system currently available.

Fig.2



AM interference

The next letter is perhaps a reminder that energy saver lamps have their problems:

I recently bought two Philips PLC Electronic lamps. Unfortunately they generate a hum in my sound system whenever it's tuned to an AM station. FM stations are OK and I can't detect any problems with the TV or the CD unit. Is there any way to overcome the problem? (C.H., Warners Bay, NSW).

The problem you're experiencing C.H. is radio frequency interference (RFI). Compact lamps such as the Philips type have an inverter that operates at around 45kHz. This circuit is a type of electronic 'ballast' that limits the current taken by the lamp. However, because it's switching this current, RFI is generated.

You'll also get RFI from some brands of light dimmer, and most computers. And trying to eliminate it can be almost impossible. AM radios are particularly susceptible to RFI, because of the nature of an AM transmission. Unfortunately there is no magic cure, except to try relocating the radio's antenna to a place where it gets more of the station signals and less of the RFI from the lamps, etc.

What??

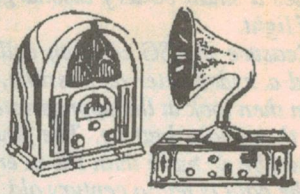
This month's question was given to me by a colleague who discovered the circuit in a ... whoops! If I tell you, it might give too many clues. The question is, what's the approximate output voltage of the circuit of Fig.2?

Answer to June's What??

The answer is 25kHz. It can be shown mathematically that if the frequency of the signal applied to the D input (fd) is larger than half the clock frequency (fc), the signal at the Q output (fq) will have a frequency equal to the difference of fc and fd. That is, fq = fc - fd. Ideally, fq should also be an integral divisor of the clock frequency (half, third, quarter and so on). So there's a way to perform digital frequency subtraction! ❖

Vintage Radio

by PETER LANKSHEAR



Vintage reading matter and references

Despite the growing interest in vintage radio worldwide, there is now a whole generation of engineers and technicians without first-hand experience of valve equipment. Fortunately there is an enormous array of suitable literature available to the vintage enthusiast who wishes to find out more about what might otherwise become a 'lost' technology. Another important field of interesting reading is the history of radio.

Complimenting the large number of current electronics publications is the rich store of books, magazines, catalogues, promotional material and manuals that has survived from the past.

Although there are plenty of general-interest electronics magazines, by reason of the specialised nature of vintage radio there are few publications on public sale dedicated entirely to this subject. Great Britain's *Radio Bygones*, published with about 32 pages six times a year, is one. I would point out though, that this excellent publication concentrates on English, European and military equipment and costs about $50 Australian, for six copies posted. However, we are well served by general coverage electronics magazines featuring regular articles and columns on the subject, *Electronics Australia* being a prime example.

Locally, the bulletins of the Historic Radio Society of Australia and the New Zealand Vintage Radio Society are productions devoted entirely to vintage radio. Published quarterly for members, these are valuable sources of reference material and are especially popular for their 'Wanted' and 'For Sale' sections. They are in fact essential to the continued success of their Societies.

Modern books

In addition to the magazines there is a good range of vintage radio reference books available, although the majority do not deal specifically with the Australasian scene. Books with international recognition that do have local application and can be thoroughly recommended are the trio from John Stokes, founding editor of the NZVRS *Bulletin*. These are *70 Years of Radio Tubes & Valves*, *The Golden Age of Radio in the Home* and with an Australian emphasis, *More Golden Age of Radio*.

British publications are generally of a high standard, although the radios described are not often seen in Australia. For readers with an interest in American equipment, there is a wide selection of titles available — although some do seem to have been written by opportunists, who, without any great depth of knowledge, are taking advantage of the current wide interest in vintage radio.

One major feature of American vintage radio publishing, of considerable interest to the historian, is the quality reprinting of manuals and booklets of the 1920's and 30's. These new/old books are excellent reproductions and make available material to which most readers would not otherwise have access. A related and valuable service is the photocopying of circuits and service data of receivers provided by some firms, and through the societies to their members. Some excellent colour calendars featuring radio cabinets are being produced.

So far we have dealt with examples of current publications, but there is a enormous amount of material of importance available to the enthusiast who is prepared to spend some effort in tracking it down. Locating old books, magazines, manuals and brochures can be as exciting and satisfying as hunting for radios themselves — and to many historians, of greater value.



Fig.1: Containing hundreds of photographs and descriptions, these books are invaluable for identifying and dating receivers. 'Radio! Radio!' concentrates on British models, but John Stokes' books are written for Australasian collectors and provide a comprehensive coverage and history of locally sold radios.

Old textbooks

A major part of serious radio collecting is the repair of receivers, and an appreciation of their technical qualities. This requires a good knowledge of the theory of receiver operation, and one the best sources of information is old textbooks. Fortunately there were many excellent books written over the years, and a look out should be kept for these.

One popular series has been the American Radio Relay League (ARRL) an-

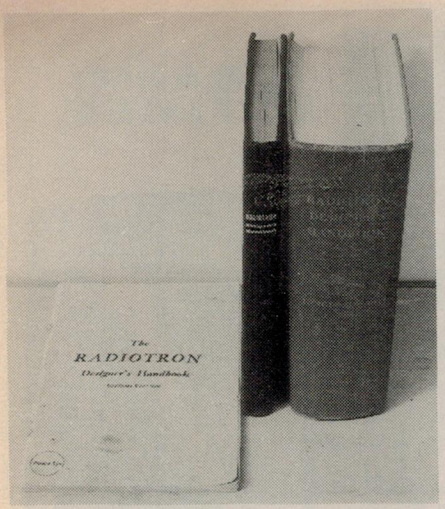


Fig.2: There can be few books that underwent such dramatic revisions as the Radiotron Designer's Handbook. In 20 years it progressed from the slim collection of data sheets in Volume 2, at left, through the popular Volume 3 (centre) to the monumental Volume 4 at right — which had at least four reprints and became a world classic.

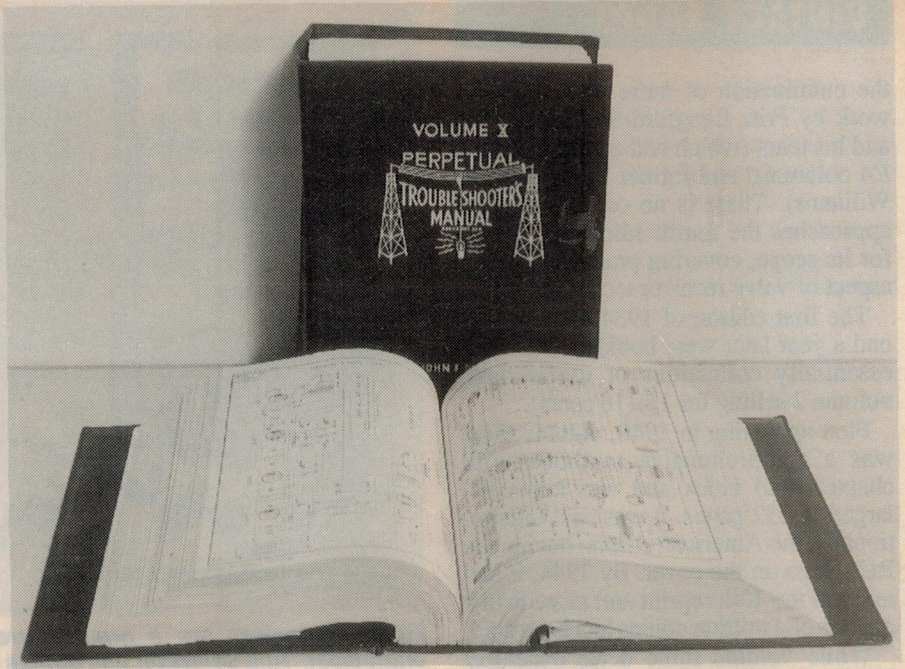


Fig.3: For many years, John F. Rider produced his annual issues of the Perpetual Troubleshooters Manual. Containing manufacturer's data on practically every American receiver, these very widely distributed and substantial manuals are now an invaluable reference for collectors and historians.

nual *Radio Amateur's Handbook*. Editions from the first, in 1926, to about 1960 or even later have very readable sections covering the operation and building of valve radio receivers. The Radio Society of Great Britain (RSGB) produced four editions of their *Radio Communication Handbook* between 1938 and 1968. More 'in depth' technically than the American equivalent, these were well written and can be recommended. For the experienced constructor, the 4th edition even has instructions for the building of a 20 valve, double-conversion communications receiver!

Valve data manuals

Very useful manuals were published regularly by the major valve manufacturers. Editions of RCA's *Receiving Tube Manual* appeared from about 1930 to the late 1960's, and as well as providing comprehensive data on valves, contain valuable reference sections including valve operation and applications.

AWV and Philips both issued Australian valve manuals. Philips published a large selection of reference books and for about 30 years, AWV widely distributed *Radiotronics*, featuring authoritative news about the latest Australian valve and circuit design developments.

For the restorer and the student, volumes of circuits which were published annually for the servicing industry are invaluable. Australian publications of the 1930's were the *Australian Radio Trade Annual* and the *Australian Official Radio Service Manual*. These are now often the only source of information about early Australian receivers.

Except for Volume One, which includes pre-1930 equipment, of less direct interest to the Australian enthusiast but in a class of their own are the American *Perpetual Trouble Shooter's Manuals*, published by John F. Rider. Brought out annually for many years, these contain in easily removable loose-leaf form, circuits and data on possibly 95% of all radios made in the USA. They are not small though, as many volumes contain something like 2000 A4 pages of circuits and information. A very similar series, but including Canadian receivers was *The Official Radio Service Manual* compiled by Hugo Gernsback's organisation.

For the serious student there are the Radio Engineering textbooks written by F.E. Terman and published by McGraw-Hill. These were standard reference books for several generations of engineers and students, and include *Fundamentals of Radio*, *Radio Engineering*, *Radio Engineers' Handbook* and *Measurements in Radio Engineering*.

The early years of British hobby radio were dominated by the legendary John Scott-Taggart, a prolific writer whose 'ST' designs appeared regularly and were built with enthusiasm by an army of home constructors. From the British publishing firms of Iliffe and Newnes came a large selection of excellent radio books featuring F.J. Camm, W.T. Cocking, M.G. Scroggie, and 'Cathode Ray', all prolific writers during the 'golden years' of radio.

It is impossible to do full justice to the vast quantity of material written during the valve era, but two specialist American authors of radio servicing books must be mentioned. John F. Rider, whose manuals have already been mentioned, and Alfred A. Ghirardi were two outstanding writers for the serviceman and books by both are always good value.

For a very readable technical history of radio in Australia from 'someone who was there', keep a look out for Winston T. Muscio's *Australian Radio, the Technical Story 1923-83*. Winston spent the better part of 50 years as an engineer for STC, and has a wealth of knowledge of the Australian electronics industry.

'Desert Island' book

For many years, a popular BBC radio programme was 'Desert Island Discs', when each week a celebrity was invited to imagine that he/she was confined to a desert island and was permitted to have just one gramophone record. Their choice obviously was made carefully, as it had to provide lasting interest and satisfaction.

If, rather than selecting a recording, I was asked to nominate a Desert Island Radio Book, I would without hesitation nominate the fourth edition of the *Radiotron Designer's Handbook*. This remarkable Australian publication was

the culmination of more than 20 years work by Fritz Langford-Smith of AWV and his team (which had earlier included *EA* columnist and former Editor Neville Williams). There is no other work that approaches the fourth edition of *'RDH'* for its scope, covering practically every aspect of valve receiver technology.

The first edition of 1934 and the second a year later were booklets that were essentially collections of useful data, volume 2 selling for 1/- (10 cents).

First appearing in 1940, volume three was a comprehensive textbook with chapters and index and was much enlarged to 352 pages. It was sold internationally, the American edition having the RCA logo on the cover. By 1944, it had reached the 10th reprint and more than a quarter of a million copies had been sold.

While volume three deals concisely with most aspects of receiver design, the real opus is volume four, running to nearly 1500 pages and first published in 1954. This was an immediate success and within three years had run into five reprints, plus an overseas edition.

Although it has been out of print for many years, for the serious student volume four of the *RDH* is well worth searching for. Every conceivable topic is dealt with in a very readable manner, so that the summaries are readily understood by the student and yet the maths are presented for the engineer who likes to work from first principles.

Old magazines

For many radio historians, the greatest finds of all are old radio magazines. Not only do they provide a wealth of information about contemporary technical developments and projects, but the advertisements are invaluable for accurate dating and identification of equipment. Given radio's popularity in the 1920's and 30's, it is not surprising that the number of dedicated magazines was considerable, and it is neither possible nor really necessary to suggest more than a few of the better known examples.



Fig.4: Magazines are a great source of information for the vintage radio enthusiast. This selection has copies from America, Britain, Australia and New Zealand. In 1932, Wireless Weekly (the ancestor of EA) cost only three pence!

Local productions

Locally there were some world class productions. Australia's leading publication was of course *EA*'s own ancestor *Wireless Weekly*, later known as *Radio & Hobbies*. New Zealand had the *NZ Radio Times* and the *Radio Record* which for several years around 1930 also produced an annual digest of circuits and data.

Britain, where radio was a very popular hobby, was the source of many hobby radio magazines such as *Popular Wireless*, but *Wireless World* is the outstanding example. Possibly the oldest radio magazine still in production, it had its origins before World War I in Marconi's company magazine. *WW* has always been an authoritative source of information and at the leading edge of technology. For example, it introduced the world to the Williamson amplifier and the Baxendall negative feedback tone control, designs which had a profound effect on the audio industry.

America, not surprisingly, has been the source of a vast number of radio magazines. One of the longest running, and probably with the most readily available back issues is *QST*. Published by the ARRL, *QST* is amateur radio's premiere periodical and despite its communications bias, is a great source of historic information.

One group of American radio magazines, is worth special mention. Hugo Gernsback, originally from Luxembourg, was a pioneer and most prolific publisher for half a century, concentrating on the repair and hobby areas with several popular magazines including *Radio News*, *Radio Craft* (later *Radio-Electronics*), *Shortwave & Television*, *Shortwave Craft* and *Radio & Television*.

Finding them...

Unfortunately it is not a matter of ordering old books from your favourite book store! Tracking them down can be as exciting and rewarding as finding old equipment. Auctions, garage sales and second-hand book and magazine shops are an obvious source, and it is a good idea to let their proprietors know about your interest. Bazaars and book sales organised by service organisations often turn up interesting finds, and are well worth visiting.

The 'For Sale' sections of the vintage radio society bulletins frequently advertise books and magazines. It is my experience that many hams are reluctant to throw out old magazines, and can be a good source especially if they know that the material is going to a 'good home'.

Libraries in large cities often keep past volumes of the major magazines and

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publications in their archives, and can be a valuable source of research material.

Names & Addresses

Fortunately there is a good supply of currently available books and reproductions stocked by specialist firms. Two American sources are the Antique Electronic Supply of 6221 S. Maple Avenue, Tempe, Arizona 85283, and the Vestal Press, PO Box 97, Vestal, New York 13851-0097, USA. These firms both publish illustrated catalogues, and accept the popular credit cards.

For those who would like to subscribe to the specialist UK magazine *Radio Bygones*, mentioned earlier, its address is 9 Wetherby Close, Broadstone, Dorset BH18 8JB, England. One year's airmail subscription is currently £23, and payment must be made in either Sterling or via Mastercard or Visa cards.

There are several Australian stockists of the more popular vintage radio publications, and advertisements appear regularly in *EA*. Three such organisations are: Orpheus Radio, R.S.D. B98, Ballarat Victoria 3352; Resurrection Radio, 51 Chapel Street, PO Box 1116, Windsor, Victoria 3181; and Nostalgic Wireless Co., 112 Union Road, Surrey Hills, Melbourne 3127. ❖

Collector's Corner

Where readers display prized items of radios and other equipment from their collections, and/or seek information from other collectors...

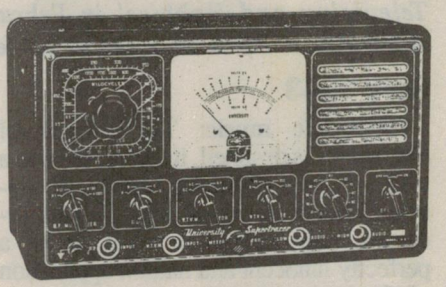
Thanks for your help!

There's no doubt about the wealth of information possessed by EA's readers, and their generosity in sharing it. Two readers responded almost immediately to my own request in the April column, for a circuit and other information on an old AWA RF Signal Generator, type 3R7231. Mr Frank Rose of Umina in NSW sent a circuit and parts list for me to copy, while Mr John Manns of the Nostalgic Wireless Company in Surrey Hills, Victoria sent me a complete manual to copy. My grateful thanks to both, for sharing this information.

Circuits, data wanted

Actually John Manns himself is in need of data, on a University Signal Tracer model AST (circa 1959). He's planning to restore it eventually, as a retirement project, and has found it difficult to track down a manual or even a circuit. Can anyone help, please? I'm reproducing a picture of it here, in case this helps someone identify the model.

Mr Gerald Micallef of Kogarah in NSW is keen to get hold of an operating manual, or



at least a circuit, for a 5" Wideband CRO made by ACE Radio of Newtown in the 1960's. He's prepared to buy the manual if necessary, or borrow and photocopy it.

Finally, for this month, Mr Max Gill of Gordon in NSW is trying to track down either the manuals or circuits for an HP type 425A DC Microvoltmeter, and a Rohde & Schwarz UHF Signal Generator type SDAF. Mr Gill also advises that my AWA 3R7231 generator was a copy of the old wartime version of the Marconi TF144 — thanks, Mr Gill.

If anyone can help Mr Manns, Mr Micallef or Mr Gill, please send the information to me and I'll pass it on to them. (J.R.)

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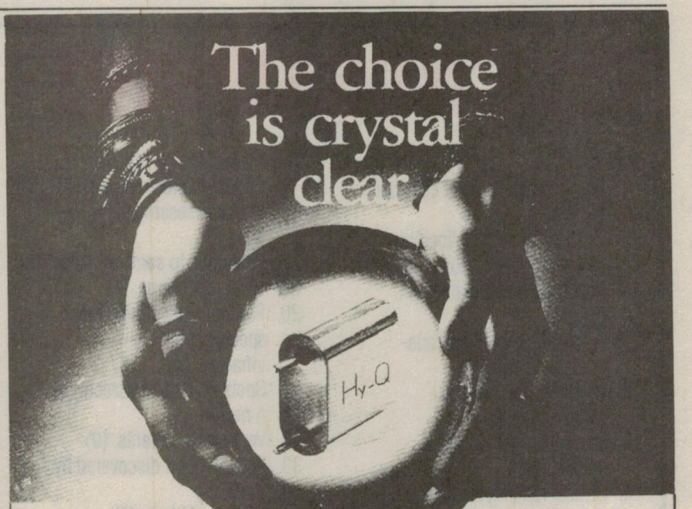
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50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

July 1943

Electronic music: The science of electronics is destined, it seems, to have a vital influence on affairs musical. The introduction of a microphone into an orchestra may appear in itself to be a perfectly innocent and natural application of electronics to music.

Natural too, for the vocalist to step in front of it, so that his or her voice actually dominates the entire orchestra. The most bashful of instruments can be made to reverberate throughout the entire auditorium.

The use of electronic amplification has shattered the limits and standards of thousands of years of purely acoustic music making. Overall or relative volumes are no longer purely a function of the vigor with which strings are plucked or bowed, but of the settings of a collection of gain controls. Fundamentally, there is no real reason why the characteristics of every known acoustic instrument should not ultimately be duplicated by electronic means.

A small group of standardised electronic instruments may well take the place of a complete orchestra, each assuming a different character, as required, by the flick of a switch.

July 1968

Error corrected telex: Philips' Simplex TOR equipment, installed in a ship's radio station, ensures an error corrected teleprinter communication between the ship and shore.

In this system, the transmitter sends out the message in groups of three characters. The receiving station checks the characters individually, and if one or more are found mutilated the whole block is considered faulty and re-transmission is requested.

The procedure is repeated until the block is received correctly, after which the next block is transmitted.

Automatic inertial navigation: The US Government has recently approved the Litton LTN-51 automatic inertial navigation system for its scheduled airliners. The LTN-51 replaces present complex navigational procedures requiring fixes and calculations which take navigators about 20 minutes to complete. Pin-point navigation is accomplished automatically in a fraction of a second.

All that is needed by LTN-51 is the latitude and longitude of the flight's destination and check points along the way. The computer does the rest. No outside radio command or information is needed for system operation. Entirely self-contained, it can navigate an aircraft anywhere on earth with precise accuracy.

Computer banking: Britain's first comprehensive nationwide computerised banking system is to be installed by the Midland Bank, which has branches all over the country. By 1971, the bank's 2000 branches will be connected directly to a network with access to five English Electric System 4-70 computers. ❖

EA CROSSWORD

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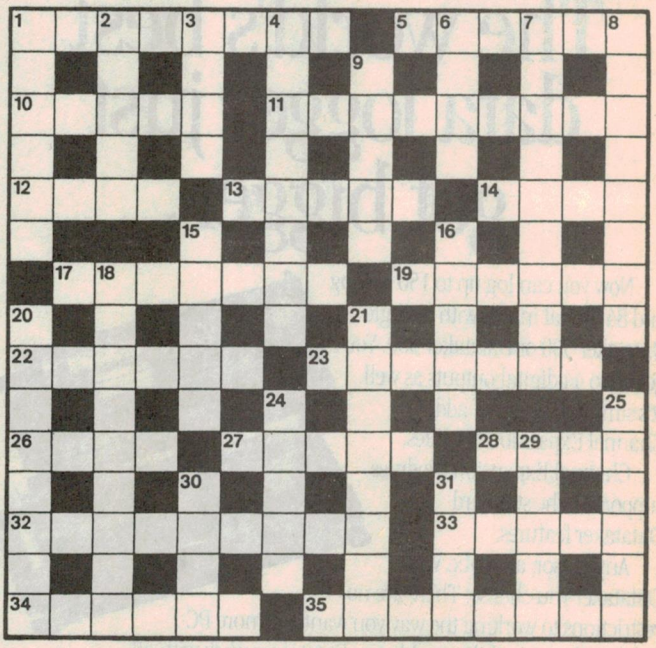
1. Energy absorber that controls temperature. (4,4)
5. Cancer-causing radioactive isotope, — 60. (6)
10. Letter of phonetic alphabet. (5)
11. Artificial radioactive trans-uranic element. (9)
12. Bunching devices for cables. (4)
13. Dummy target for active missile. (5)
14. Critical reading for balancing measurement. (4)
17. Part of an electron gun. (7)
19. Shock assessment, the —— test. (6)
22. Responds to some stimulus. (6)
23. Vinyl recordings. (7)
26. Part of the electromagnetic spectrum, the —— infra-red. (4)
27. Spots on a radar screen. (5)
28. A meson. (4)
32. Very small currents. (9)
33. Phenomenon discovered by Hertz. (5)
34. System of ideas. (6)
35. Small power supply (4,4)

SOLUTION FOR JUNE 1993

	S	I	L	I	C	O	N	V	A	L	L	E	Y	
S	O	D	C			O	X	C						
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DOWN

1. Science dealing with radiation, —— physics. (6)
2. Renowned brand of computer. (5)
3. Lateral movement of antenna tower. (4)
4. Brand of computer games. (8)
6. Musical work. (4)
7. Make water conductive. (9)
8. Patterned plate for design transfer. (8)
9. Reel for tape or film. (5)
15. Greek letter. (5)
16. Picture on screen. (5)
18. Cumulative ionisation process. (9)
20. Send a signal from an antenna. (8)
21. Electric grind, the sink —— unit. (8)
24. The —— test can identify certain elements. (5)
25. Use key to faciltate access. (6)
29. Country of birth of Nobel prize-winning discovered of Raman effect. (5)
30. Danish physicist, Niels —— had a 34 across. (4)
31. Abbreviation often found on a CRO panel. (4)



EA with ETI marketplace

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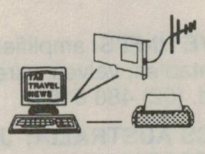
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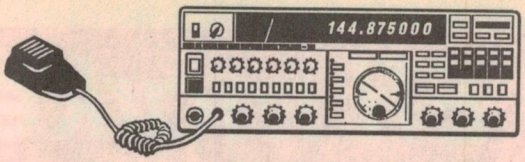
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continued next page

Amateur Radio News



Riverina field day

Barry Gilmour VK2KUZ advises that the Wagga Amateur Radio Club Inc is hosting this year's second Riverina Field Day at Wagga Wagga, on the weekend of August 14-15. The first Riverina Field Day was hosted by the Twin Cities Radio and Electronics Club at Albury last year, and it is hoped that the event will become an ongoing yearly one, hosted alternately by the two clubs.

The venue this year is the Murrumbidgee Turf Club, situated very close to the city centre. This provides both carpeted indoor areas as well as a very large undercover outdoor area, and is thus ideal for a function of this type.

Beveridge passes on

Harold H Beveridge, ex-W2BML and inventor of the Beveridge receiving antenna, died in January in New York state. He was 99 years old.

Dr Beveridge originally dubbed his directional long-wire antenna the 'wave antenna'. Developed in 1917 to enhance communications between the US and Europe during WWI, it was first described in *QST* in November 1922. With more than 40 patents to his name, Dr Beveridge considered his two greatest inventions were the wave antenna and diversity reception (which combats effects of fading).

Dr Beveridge received the American Institute of Engineers' Gold Medal in 1957 for his work in 'national and world-wide radio communications'.

Growth in Japanese amateurs

Writing in *Amateur Radio*, the WIA's general manager Bill Roper VK3ARZ notes that the number of amateur radio operators in Japan had reached almost one and a quarter *million* by September last year. With 1,242,550 stations licensed, amateurs represented 15.5% of all radio and communications stations licensed in Japan at the time. In the three months between June and September, the number of amateur licensees grew by 20,336 — that's more than the total number of amateurs in Australia!

Societies become one

Canadian amateurs have had the choice of belonging to two amateur radio organisations for some years — the Canadian Radio Relay League and the Canadian Amateur Radio Federation. The two societies merged in May, to form the Radio Amateurs of Canada.

The two societies held their final individual meetings on 1 May; their respective publications, *QST Canada* and *The Canadian Amateur*, were both due to publish in May and June. Their new joint magazine, *The Canadian Amateur*, will appear for the first time in July.

No change of name

The ARRL has apparently abandoned further consideration of a name change, put forward last year. That proposal had suggested that the League change to the 'American Amateur Radio League'.

In January the ARRL's Board also resolved to continue support for Morse Code proficiency below 30MHz, as presently required under ITU regulations. They cited the code's longevity as a licence requirement and its ability to overcome language barriers.❖

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AUST FIRM TO DEVELOP UNSW 'TIME OF FLIGHT' MASS SPECTROMETER

LOCALLY DEVELOPED ANALOG WORKSTATION IS PROGRAMMED USING SCREEN ICONS

REVIEW: THE LATEST VERSION OF ISSPICE



NEW 500MHZ DSO'S FROM TEKTRONIX PROVIDE A FULL COLOUR DISPLAY FOR EASIER WAVEFORM RECOGNITION, USING A RELIABLE LIQUID-CRYSTAL SHUTTER SYSTEM

NEWS HIGHLIGHTS

AUST FIRM TO DEVELOP UNSW MASS SPECTROMETER

Australian firm GBC Scientific Equipment, of Dandenong in Victoria, has signed an agreement to develop a new and greatly improved mass spectrometer invented by a team led by Dr Michael Gilhaus, Senior Lecturer in UNSW's Department of Analytical Chemistry. The agreement, between Unisearch and GBC has given GBC exclusive rights to commercialise and further licence the manufacture of the new mass spectrometer.

Unisearch is the wholly owned research, development, technology transfer, consultancy and training company of the University of New South Wales. It holds worldwide patents for Dr Guilhaus's spectrometer.

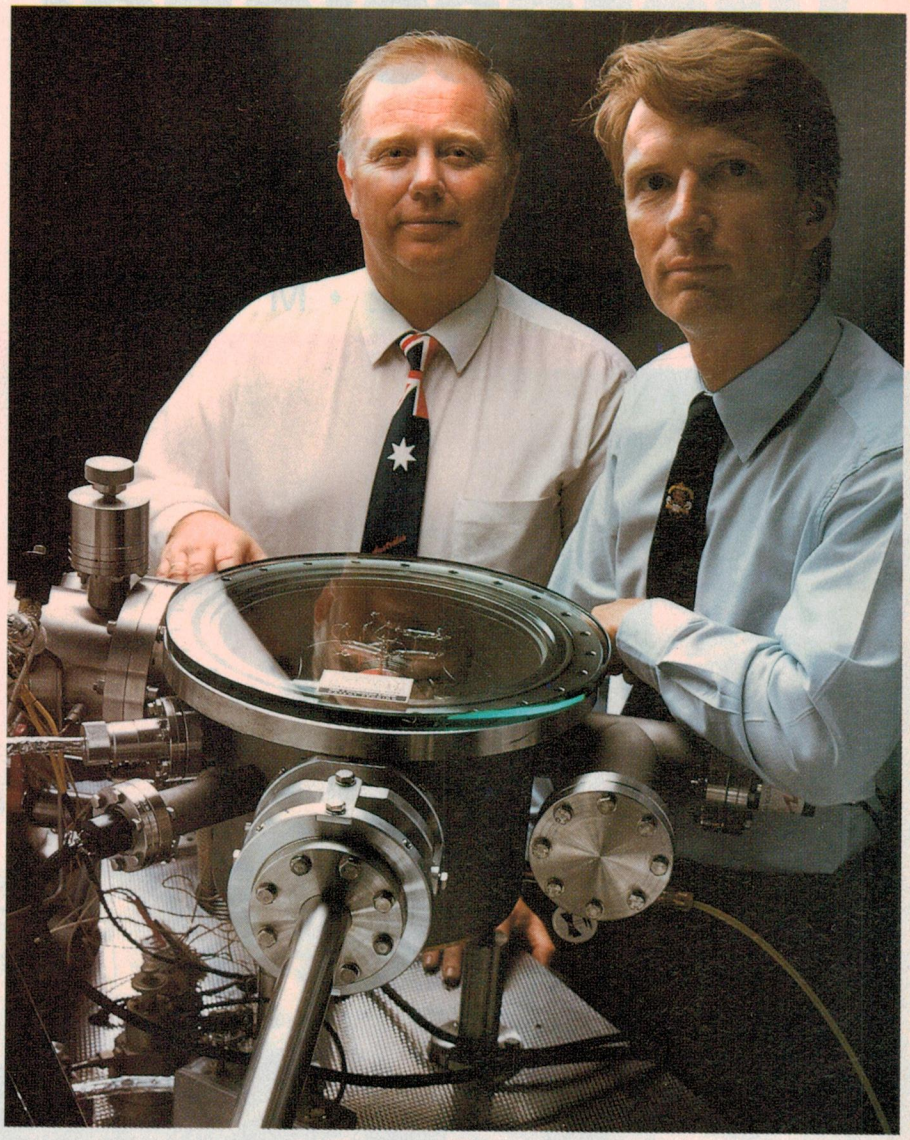
GBC, founded in 1978, is an Australian scientific instrument manufacturer which has built a strong international market, based on a worldwide reputation for the excellence of its instruments.

Mr David Hogg, Business Manager of Technology Transfer for Unisearch, said that after discussions with many of the leading international scientific equipment makers, all of whom had shown interest in the instrument, he and Dr Guilhaus had determined that GBC was the company in the best position to commercialise the new mass spectrometer.

The spectrometer has been named TOF-oa, for time-of-flight/orthogonal acceleration, which describes the instrument's operating method. In time-of-flight mass spectrometers the time taken by ions of different masses to pass down an evacuated tube, the flight tube, is accurately measured: the longer the time, the heavier the particle.

Recent advances in high speed electronics and computers have made it possible for time-of-flight instruments to achieve much higher performance than other mass spectrometers of comparable or greater complexity. The TOF-oa instrument uses orthogonal acceleration, in a unique and innovative way to overcome physical problems which had plagued time-of-flight spectrometers.

"Before our approach," said Dr Guilhaus, "all time-of-flight instruments for mainstream chemical analysis were faced with the problem that the gas particles subjected to ionisation had random initial velocities. These random velocities, combined with the controlled velocity given to the ions before their time of flight, were measured.



Dr John Coles (left) with Dr Michael Gilhaus.

"The random velocity components 'blurred' the measurement of the time of flight of specific ions and thereby limited the resolving power of the instruments, compared to other more complex mass spectrometry techniques. Resolving power in mass spectrometry is the critical ability to detect small differences in mass."

The solution to the problem was simple and elegant. "Using an electrostatic lens, or possibly another means, we first make a parallel, 'slow' beam of ions," Dr Guilhaus said. "The ions in this beam have little or no velocity at right angles (orthogonally) to the beam, although they still have their random velocity in the direction of the beam.

"By electrically accelerating portions of the beam of ions orthogonally and letting the ions drift to the detector, which is parallel to the original beam, we can eliminate the effect of the initial random velocities of the ions and make the mass measurement very ac-

curate and sensitive. That, at least, was the theory. We built a computer program which indicated that the theory was valid. Then, with funding that took us about two years to raise, we built a prototype to test the theory."

"You can imagine our delight when the prototype performed exactly as predicted from the very first run."

With further tuning by Dr Guilhaus and Dr John Coles, an ARC-funded Research Fellow who has been working on the TOF-oa for the past 20 months, the instrument has gone on to exceed its design resolution by about 30%. It can now distinguish between two ions with masses of 4000 and 4001 atomic mass units; a high achievement for a small mass spectrometer.

FAST RUNUP FOR ATVI BASE STATION

When the Australian Broadcasting Corporation (ABC) transmitted its first international television programs by satellite to South East Asian countries in February, this was achieved through a $500,000 earth station engineered and installed in Darwin in a miraculously short time-frame, by Scientific-Atlanta Australia.

The ABC's new Australia Television International (ATVI) service will beam Australian news and current affairs, entertainment, sport and cultural programs to a broad South East Asian viewing audience of over 200 million people from the up-link facility in Darwin.

ATVI will be on Indonesia's Palapa B2P satellite alongside American broadcasters including CNN, HBO and ESPN, as well as various South East Asian program services and other local programs, such as TVNE.

The service, which will initially broadcast TV for eight hours a day, and radio programs 24 hours a day, signals Australia's entry into 'Sky Wars' — the race to provide some of the satellite programming to countries where strong economic growth is giving rise to greater disposable incomes and an appetite for western programming.

The countries that the ABC television and radio signals reach include Indonesia, Brunei, The Philippines, Thailand, Hong Kong, Taiwan, Papua New Guinea, Vietnam, Laos, Southern China, Malaysia, Singapore, Burma, Bangladesh and Cambodia.

The contract to establish the Darwin earth station was let on October 26 last year. Because the ABC wanted to start transmitting within four months of that date, Scientific-Atlanta was given just 96 days to supply the equipment, install the fully motorised seven metre transmit/receive antenna and commission the system.

Normally a large system of this nature takes around six months to install but Scientific-Atlanta, a Sydney based company, using a team of their top engineering staff, completed the project on the 95th day. A potential risk to the schedule was the likelihood of severe storm activity during the New Year monsoons. Fortunately, the weather took a kind view to ABC's aspirations.

The Scientific-Atlanta engineering team leader, Mr David Wheeler, said the system has been designed for reliable unattended operation, 24 hours a day. The high power amplifiers (Varian 3.3kW units) are fully redundant, such that if one fails, the other will immediately take over the transmission.

Similarly the Scientific-Atlanta video exciters are fully redundant with automatic changeover.

NEW CHARGE CARD STAYS IN POCKET

Ramtron International Corporation and Racom Systems, Inc of Colorado USA, have unveiled a new type of charge card which eclipses all previous electronic transaction cards, both 'credit' and 'smart', with its convenience, speed and accuracy.

The 'In-Charge' electronic debit card, which removes the need to carry cash, merges Racom's RF transaction processing technology, based on wireless data transfer via radio waves, with Ramtron's non-volatile FRAM memory technology — which enables data to be retained without the need for power or battery

QLD FIRM EXPORTS $1M IN HEART MONITORS

A Queensland heart monitoring equipment manufacturer recently reached the $1 million mark in exports. Located on the Department of Business, Industry and Regional Development's (DBIRD) technology park on the Gold Coast, Micromedical Industries manufactures hand-held devices that measure, display, store and print a full range of cardiac information.

Managing director Alan Liddle said the company exported more than 90% of its products to more than 15 countries, and had now established a base on which to build a substantial business, both in the export of medical equipment and the provision of cost effective medical monitoring services.

"We manufacture several devices designed for either the physician or the patient," Mr Liddle said. "The monitors are lightweight and portable — small enough to fit inside your coat pocket — which is beneficial in times of emergency."

The company's Biolog ECG monitor measures the heart rate of patients and provides accurate information easily.

Its Paceview pacemaker monitor measures pacemaker functions and has the ability to detect problems such as lead fracture, malfunction and battery depletion.

"These products are targeted primarily at general practioners," Mr Liddle said.

Pace Tel and Heart Tel are devices designed for the patient and can be used at home. Both monitors store cardiac information which can be sent via the telephone to doctors who are able to print out and analyse the information.



Further information is available from Micromedical Industries, 11 Technology Drive, Labrador 4215; phone (075) 973 455, fax (075) 940 361.

back-up. A tiny FRAM chip is encased in the card.

Racom Systems is two thirds owned by Australian interests. AWA Limited, Intag International Limited of Sydney and Ramtron International Corporation of Colorado Springs, USA, each have a third share in the company.

"The 'In-Charge' card lets transactions happen without delaying the movement of people and objects," said Richard Horton, president of Racom.

"No more stopping, digging in your pocket or purse for loose change. You simply walk through, board the bus and train or enter the cafeteria without even having to remove your 'In-Charge' card from your pocket, and the amount of 'money' left on the card will be decreased by the cost of the transaction. No other card puts people as 'in charge' or in control of their time, money, and the release of their personal information."

The 'In-Charge' card does not require any physical contact with a scanner because the data stored in the FRAM chip on the card is sent by radio waves to a PC-based scanning device and in so doing processes the transactions without contact at speeds undetectable by human perception.

2.5GBPS ALONG A SINGLE FIBRE

Siemens has delivered to Telecom Australia a pilot transmission link that will be the fastest long line optical fibre communications link yet to be installed by Telecom between capital cities within Australia.

The transmission equipment is based on the new Synchronous Digital Hierarchy (SDH) technology, which Telecom is now introducing into its network. As an example of its capacity, the equipment can transport in excess of 30,000 simultaneous phone calls, transmitting these down the one fibre at a line bit rate of 2488.320 megabits per second.

The pilot link to be installed between Sydney and Canberra will consist of two separate paths — one that will be configured to act as a main path, and one as a standby path.

This system provides protection so that, should one of the links fail — perhaps due to a fibre break — the traffic will be electronically switched to the standby path. The resulting high degree of transmission security will be translated into a high quality of service to Telecom's customers.

The success of this and other related SDH projects has been largely due to the close cooperation between Telecom Australia and its equipment suppliers.

LOCALLY DEVELOPED 'ANALOG WORKSTATION'

When provided with suitable hardware interfaces and software, a personal computer can be used for monitoring, analysing and acting upon analog data. However until now, this required a high level of programming and hardware expertise — skills that many scientists, engineers and laboratory workers have not had the time or opportunity to acquire.

But this has now changed, because local Australian firms Associative Measurement and Intag International have developed the AMLAB Analog Workstation, a flexible PC-based system which combines modular hardware with a specially-written software package, using a novel graphical user interface and easily mastered icon-driven programming. The firms claim that as a result, the AMLAB system allows virtually anyone to automate the acquisition, monitoring, processing, display and storage of analog information very easily — along with programming of control actions and events.

Intag's Technical Director Ray Wood explains that the AMLAB hardware is modular, and carefully designed to obviate interfacing problems in the vast majority of applications. It includes both powerful DSP modules and analog interfacing modules, designed to be compatible with any standard IBM-compatible PC.

However in many ways the key to the system is its powerful software, which allows the user to program a very wide range of data acquisition, processing, manipulation and control tasks simply by placing graphical icons on the screen, and linking them to achieve the desired results.

Users already include many universities and medical research laboratories, the CSIRO, the Aeronautical Research Laboratories, BHP, the NSW State Rail Authority and the Electricity Commission of NSW.

Further information is available from Intag International at 9th Floor, Kyle House, 27-31 Macquarie Place, Sydney 2000; phone (02) 252 4055, fax (02) 252 4064.



AUST MAY SOON BE ALONE WITH 240V

The International Electrotechnology Commission (IEC) Technical Committee responsible for Standard Voltages is proposing to alter the standard tolerances in IEC 38 (Standard Voltages). The proposal, if accepted, would make the 240/415V system used by Australia and the UK a non-standard voltage.

The UK has now dropped its opposition to any such change, and will move to harmonise its 'low voltage public electricity supply' at 230V. From January 1, 1995 the relevant UK regulations will require a nominal supply of 230V with a permitted voltage tolerance range of +10%/-6%. From January 1, 2003 the regulations will be further amended to require a nominal supply of 230V, with a permitted range of +10%/-10%.

As a result Australia will become the only major developed country to be using 240 volts. The change in the UK position has significant implications, and it is likely that appliance and equipment suppliers will increasingly focus designs, etc., on 230/400 standards.

ACF ENDORSES LOCAL CF LAMP

For the first time in its 27 year history, the Australian Conservation Foundation has endorsed a product on the basis of its strong environmental credentials.

ACF Executive Director Ms Tricia Caswell announced that the Smart Lamp compact fluorescent light globe would be the first product to carry the ACF endorsement logo.

The lamp is made in Australia by Electronic Ballasts and marketed by the three brand names — Smart Lamp, Performer and Energy Choice. Ms Caswell said the product had been chosen because it was the best of its type in the world and delivered significant environmental benefits through energy efficiency and reduction in waste. The fact that the product was designed and manufactured in Australia and is competing against imported lamps was also an important criteria.

The Director of Electronic Ballasts, Mr Bruce Dwyer, said the endorsement of the Foundation was of vital importance as the Australian community gave a high credibility to the organisation and was less ready to accept at face value the environmental claims made by manufacturers themselves.

Mr Dwyer said this is particularly the case with compact fluorescent lamps where technical problems with harmonic distortion meant that some imported lamps were not able to achieve the same reductions in energy use. Electricity authorities, and therefore tax payers were being asked to subsidise the higher system energy wastage caused by the current from these lamps.

Lamps which cause problems through harmonic distortion have been banned in Victoria since March 1, 1993, and will be banned nationally by September.

Ms Caswell said she hoped the phase-out date could be brought forward to June and warned consumers not to buy these imported one-piece compact fluorescents even at a reduced price.

Consumers should identify the Australian Conservation Foundation logo on the Smart Lamp, Performer or Energy Choice brands to ensure buying the environmentally preferable product. The ACF will be writing to State and Federal Governments requiring the new Australian standard to come into force in June.

NEWS BRIEFS

- ***NSD Australia*** is now the official distributor in Australia and NZ for the RIFA and EVOX range of capacitors. Alan Brodie has been appointed as Product Manager to supervise this area.
- The Head Office of ***Protel Technology*** has moved from San Jose to larger premises at 4675 Stevens Creek Blvd. Suite 200, Santa Clara CA 95051-6764, USA; phone (US) (408) 243 8143, fax 243 8544.
- ***Sprinter Products*** has been appointed as a distributor of hard disk drives for US-based Micropolis, which manufactures super capacity disk drives.
- Mr Will Hutchinson takes over as Managing Director of ***Thomas Electronics of Australia*** from Mr H.W. Hutchinson who becomes non-executive Chairman of the Board. Mr Leno Pavlides is the new Melbourne Sales Engineer.
- Following the resignation of Mr Adrian Stephens as Managing Director, ***Roland Digital Group*** has appointed Mr Bill Kaliviotis to take control of the company.
- The Federation of Leisure Activity Groups (FLAG) will host ***Hobbyfest '93*** at Sydney's Easter Creek Raceway from 2nd - 4th October. The Expo will feature hobbies, games and pastimes. For more information contact Exhibitor Services, PO Box 314, Carlingford 2118; phone (02) 872 6255, fax 872 6879. ❖

RUSSIA TO LAUNCH INMARSAT SATELLITE

Inmarsat and DB Salyet have signed an historic contract for the first launch of a western built satellite on a Russian Federation launcher.

The US$36 million contract is for the launch of an Inmarsat-3 satellite on a Proton rocket from the Baikonur Cosmodrome in Kazakhstan, CIS, scheduled for 1995. Inmarsat will incur several million dollars in additional costs related to this launch, in ensuring compatibility of the vehicle and launch support services. There is also the possibility of incurring additional expenses because of the pioneering nature of the launch.

"It is befitting of an international organisation dedicated to the peaceful pursuit of satellite communications to be the first Western company to launch a satellite on a Russian launch vehicle," said Inmarsat director-general Olof Lundberg.

"The countries which make up the CIS have played a significant role in the growth and development of Inmarsat since its inception in the late seventies," he added.

In addition to the Russian Federation being a founding member of Inmarsat, Inmarsat's extensive network of land earth stations around the world includes stations at Nakhodka in the Russian Federation and at Odessa in the Ukraine. Also, Inmarsat-A voice and data terminals have been manufactured in the Russian Federation since the mid-1980s and approximately 1600 of these terminals are currently in use in the region.

Inmarsat has awarded a launch contract to General Dynamics of the USA for the first two of its Inmarsat-3 satellites, and to Arianespace of France to launch the third. Proton will launch the fourth Inmarsat-3.

AUST NICAD CHARGER WINS DESIGN AWARD

A portable, high-powered battery charger and processor developed for use by the military has earned an Australian Design Award for its outstanding performance.

The Intapulse M24, manufactured by Sydney company Intapulse Australia, has the ability to rapidly recharge nickel cadmium (NiCad) batteries. According to John Seymour, Managing Director of Intapulse Australia, the Intapulse M24 is so effective it actually prolongs the life of NiCad batteries.

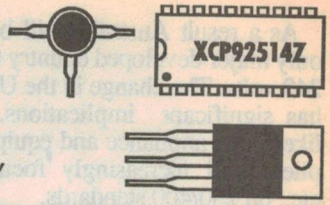
"The unit, a microprocessor-controlled, six channel battery charger, employs sophisticated pulse charging technology in a portable unit capable of simultaneously charging six 'Raven' 24V, 4Ah/1.2Ah batteries in one hour," Mr Seymour said.

"The innovative method of charging and processing NiCad batteries decreases battery down time and increases battery operating efficiency. The result is a cooler battery with increased capacity, control of the NiCad 'memory' and increased battery life," he explained.

Mr Keith Jordan, General Manager of the prestigious Australian Design Award program, said that the panel of experts which assessed the Intapulse M24 was impressed by the excellent performance of the unit.

"All the panel members agreed that the Intapulse M24 more than meets the strict specifications set by the Australian Army's communications project. The unit not only recharges Nicad batteries but also has the ability to test their status and strip any retained memory, thereby reconditioning to a near-new condition batteries which would otherwise be scrapped," Mr Jordan said. ❖

Solid State Update



KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Smart-power ICs

Siemens is now offering four new 'smart-power' monolithics. These include an intelligent low-side switch rated up to 4A (type designation TLE 4224) and an intelligent double low-side switch rated 2x4A (TLE 5224G) in the P-DSO 24 SMD package.

Another new addition is the 4A motor bridge (TLB 5023) with integral free- wheeling diodes. This chip is optimised for driving DC motors in reversing mode. Also new is the stepping motor driver (TLE 5250), which is designed to control current in the winding of a bipolar stepping motor in microstep mode.

The new SPT process (smart power technology) combines three technologies on a single chip: DMOS for extremely low-dissipation power stages, bipolar for highly accurate analog functions, and CMOS for extensive logic functions.

Particularly noteworthy is the extremely low turn-on resistance of the DMOS power transistors of 0.5 ohms power output, overload and polarity protection, and output voltage limiting up to 60V for the demagnetisation of induction loads. Both switches have an operating range of 6.5 to 45V. A status output indicates open load, overcurrent and overtemperature.

In the case of motor bridge TLE 5203, the turn-on resistance of the short circuit proof output stage is 2 x 0.4 ohms per output transistor.

For further information circle 275 on the reader service coupon or contact Siemens Advanced Information Products, 544 Church Street, Richmond 3121; phone (03) 420 7345.

5.5GHz prescalers

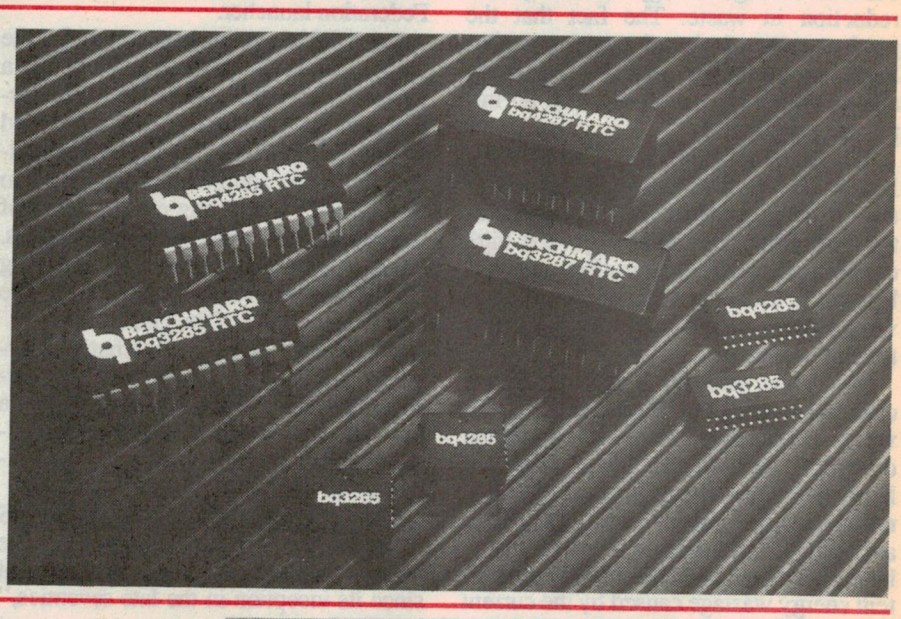
Hewlett-Packard has introduced two advanced silicon bipolar MMIC(1) digital divide-by-4 static frequency dividers (prescalers).

The IFD-53110 and IFD-53010 are suitable for a range of applications at up to 3.5GHz and 5.5GHz, respectively. Typical applications include use in the stabilised or digitally-controlled local oscillators used in global-positioning systems (GPS), satellite communications and other microwave receivers, and in frequency synthesisers and frequency counters.

AT bus clock replacement

Motorola has announced the discontinuance of the MC146818 Real Time Clock, but replacements are available using the RTC's from Benchmarq Microelectronics. The MC146818A required 25 external components. The bq3287P and bq3287S are drop-in replacements, whereas the bq3285 needs changes only to pin numbers 20 and 21.

The MC146818B and MC146818BM are totally compatible with the 3287. Benchmarq Microelectronics can provide schematics to allow easy conversions from these popular Motorola Real Time Clocks in Motorola and Intel based computers. For further information circle 272 on the reader service coupon or contact DCS Australasia, Blackburn 3130; phone (03) 878 0344.



UHF linear transistors

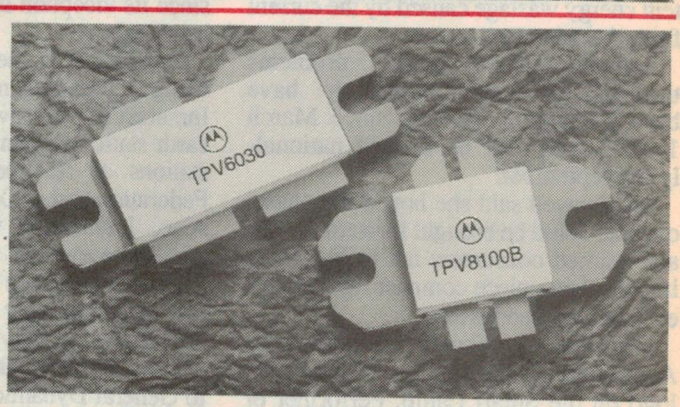
Motorola has announced two new UHF linear transistors for television transmitter applications.

The TPV6030 transistor is a class A, ultra-linear device with 35W of output power and 9.5dB minimum gain across the frequency band of 470 to 860MHz.

The TPV8100B transistor is a class AB, linear device rated at 100W output power at 1dB gain compression, but capable of 150W peak sync power with 8.5dB gain across the same frequency band.

Both transistors are in push-pull packages and are designed for high reliability and long life-times, characteristics which allow the design of a new generation of fully solid state UHF TV transmitters and transposers.

For further information circle 271 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.



The IFD-53010 operates from 150MHz to 5.5GHz; the IFD-53110 operates from 150MHz to 3.5GHz. These ECL(2) compatible frequency dividers feature a typical sensitivity greater than -15dB, power output of -5dBm (typical), phase noise of -143dBc/Hz at 1kHz offset from a carrier at 3GHz, and operation with a maximum 50mA current at 5V DC with either polarity.

For further information circle 274 on the reader service coupon or contact VSI Promark Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 4655.

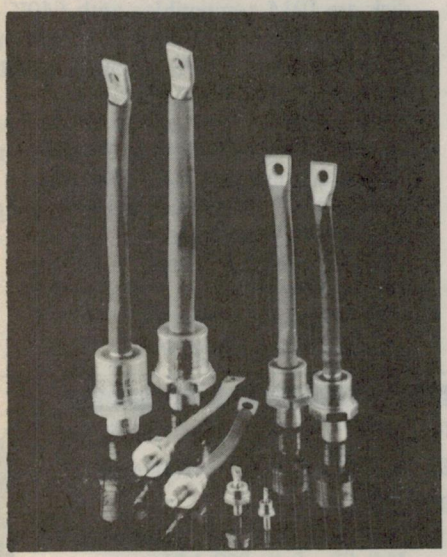
Charge-pump voltage converter

The new Maxim MAX1044 is a higher frequency and lower supply current, pin-compatible upgrade to the industry standard ICL7660. It is a switched-capacitor (charge-pump) voltage converter that can invert, double, or divide the applied input voltage without using inductors.

A 'boost' pin allows the oscillator frequency to be raised by a factor of six from 10kHz to 60kHz. Higher frequency operation lowers the output impedance, which allows more output power and keeps output ripple noise above the audio band. It also allows the use of smaller capacitors, saving space on the PC board.

The MAX1044 uses less supply current than the ICL7660 or the LTC1044, thus extending battery life. Its supply current is 30uA (typ.) and 220uA (max. over temperature). Disabling the internal oscillator cuts its supply current to 10uA (vs. 20uA for the LTC1044). Also the MAX1044 accepts input voltages up to 10V (vs 9V for the older IC).

For further information circle 279 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.



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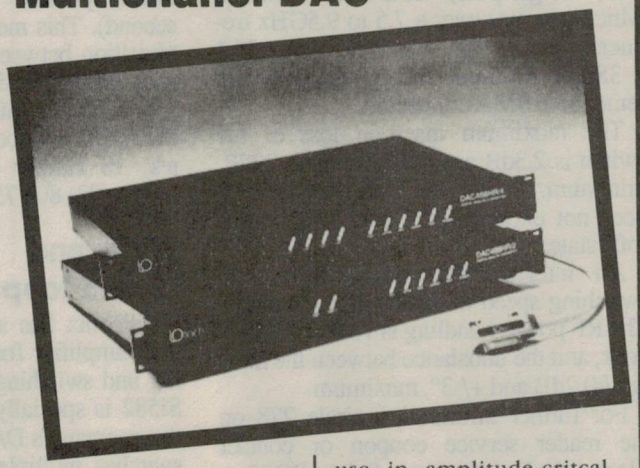
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READER INFO NO. 21

PRODUCT HIGHLIGHT — New from 10tech

IEEE 488.2, 100 kHz, 16-Bit Multichanel DAC



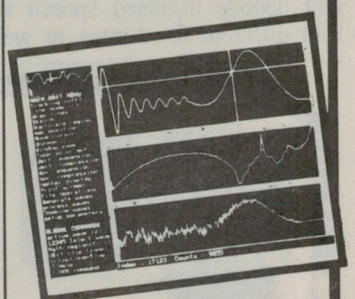
The 100kHz, 16-bit DAC 488HR digital to analog converter (DAC) offers IEEE 488.2 programmability and up to 4 isolated analog output channels in a 1.75-inch rack-mountable package. The unit features the capabilities of several traditional IEEE 488.2 instruments at a fraction of the cost. For example the DAC488HR's step, burst, waveform, and continuous-trigger modes enable it to provide stepped voltages like a precision voltage source, long arbitrary waveforms like an arbitrary waveform generator, or sine, triangle square, and sawtooth functions like a function generator.

High Resolution, Multiple Channel Analog Output

Unlike function generators and other signal source instruments, which typically provide only one output channel, the DAC488HR offers either 2 or 4 electrically isolated output channels, making it ideal for applications that require multiple channels that can operate synchronously. Similarly, in contrast to the 8- or 12-bit resolution provided by function generators, the DAC488HR offers 16-bit resolution, making it ideal for use in amplitude-critcal, audio-frequency applications.

Independent Buffer Management

The DAC488HR features an 8 K sample/channel buffer that is optionally expandable to either 128 Ksamples or 480 Ksamples/channel. Waveforms can be loaded into the DAC488HR's resident buffer from the IEEE488 bus at up to 400Kbytes/ second, minimizing the data transfer time necessary to load large waveforms into its memory. For applications that require high speed output of very large waveforms, such as audio testing and speech research, the DAC488HR can continuously output data from the IEEE 488 bus to a digital to analog converter channel at 100 Ksamples/second.



R4 software creates waveforms for generation by the DAC488HR

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Sydney (02) 344 5200 Fax (02) 349 2602
Adelaide (08) 281 3788 Fax (08) 281 4194

READER INFO NO. 22

SOLID STATE UPDATE

High frequency SP4T switch

Miteq has recently introduced a low-loss, single-pole, four-throw switch, which operates over a 7.5 to 9.5GHz frequency range. The switch measures 38.1 x 38.1 x 10.2mm, and is supplied with removable SMA connectors.

The maximum insertion loss of the switch is 2.3dB and its isolation is 29dB, minimum. In its 'on' state, the VSWR does not exceed 1.5:1, and 1.7:1 in the 'off' state.

An integral TTL driver delivers a switching speed of 100ns, hot switching. The RF power handling is 10W CW, 50W peak, and the unbalance between the arms is +/-0.2dB and +/-3°, maximum.

For further information circle 278 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999, fax 418 6550.

Speech compressor

Qualcomm has released the Q4400 Variable-Rate Vocoder, a VLSI circuit implementing the QCELP (Qualcomm Codebook Excited Linear Predictive code) speech compression algorithm. The proprietary QCELP speech compression algorithm is so powerful that compression rates up to 16:1 can be achieved while maintaining high quality performance.

Qualcomm's Q4400 Vocoder provides an easy to implement, high quality, cost effective method for speech compression.

The full duplex, single chip Q4400 Vocoder achieves near-telephone voice quality with under 10kbps compressed speech. It also offers the ability to encode and decode digitised speech signals at four different fixed rates, as well as real time variable data rate. In fixed rate mode, the Q4400 can be selected to code speech at 4kbps, 48kbps, 8kbps or 9.6kbps. In variable rate mode, it automatically adjusts the optimal data rate from 800bps to 9.6kbps for encoding on a frame-by-frame basis (50 times per second). This method provides a smooth transition between data rates, so that the user does not notice the change.

For further information circle 277 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Wideband closed-loop amp

Siliconix has a new closed-loop, low gain amplifier for wideband signal routing and switching applications. The new Si582 is specially designed for use with the company's D/CMOS wideband/video switches, multiplexers, and crosspoints.

Together, these wideband ICs will improve system performance while reducing component count, design complexity, board space, power dissipation and costs.

The Si582 amplifier features high bandwidth (180MHz), low signal distortion (-60dBc at 20MHz), excellent gain flatness (0.4dB to 50MHz), fast settling time (0.05% in 12ns), and low power dissipation (150mW). Its closed-loop design uses current feedback to achieve high accuracy and to minimise signal degradation. The Si582 also has the low differential gain (0.1%) and low differential phase (0.01 degree) that are crucial for professional/studio applications.

The amplifier is ideally suited for low gain, wideband applications such as video switching/routing for video equipment, radio communications, data communications (e.g., local area networks and ISDN equipment), automated test equipment, and high-resolution displays.

For further information circle 276 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766, fax (02) 647 1545.

RF impedance matching program

Motorola has developed an Impedance Matching Program that will be of considerable interest to RF application engineers. The software offers a simple, fundamental and graphic way to design RF power amplifiers, particularly in the initial phases of a circuit design.

The Impedance Matching Program's database contains all of the Motorola high power devices having input and output impedances as a function of frequency. It allows these to be used as starting points to design appropriate matching circuitry to connect the input to the source and the output to the load.

Effects of matching elements, as they are selected, are displayed on the Smith Chart, and changes in values can be observed visually to permit the user to optimise a matching circuit to obtain the best results over a desired band of frequencies.

Hardware requirements to use the 5-1/4" Impedance Matching Program data disk are IBM compatibles with 640K of internal memory, a 80286 or higher microcontroller, VGA Graphics Adaptor and a mouse (recommended).

To obtain a copy of the Impedance Matching Program, write to the following address and request DK107/D:

Motorola Semiconductors Hong Kong,
Literature Warehouse,
Silicon Harbour Centre,
2 Dai King Street,
Tai Po Industrial Estates,
Tai Po, Hong Kong. ❖



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HEWLETT PACKARD

Circuit Simulation Software Review:

Intusoft's IsSpice is much upgraded

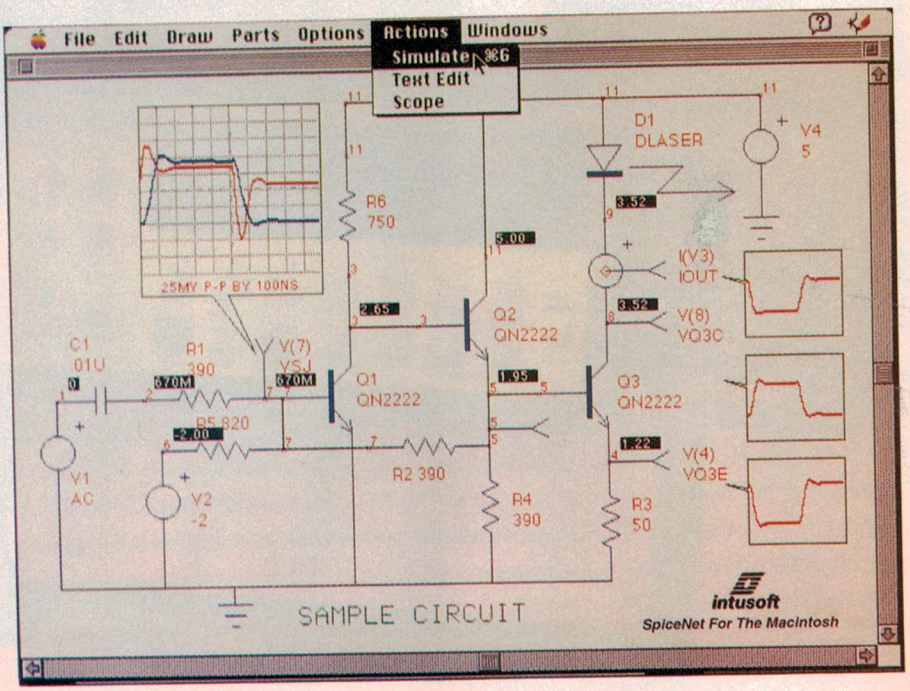
Since the July and October 1991 issues, when we first looked at the Intusoft suite of circuit design software based around their *IsSpice* simulation 'engine', the people at Intusoft have produced a steady stream of significant upgrades. It has taken longer than we'd like to become familiar enough ourselves with the new programs, in order to attempt a follow-up review; but finally we're having a shot. We look here at the final version of the pre-simulation processor *PreSpice 3.0*; the new schematic capture package *SpiceNet 3.0*; the improved device/subcircuit modelling package *SpiceMod 2.1*; and the new 'next generation' *IsSPICE 3* simulation engine, based on the full current version of Berkeley SPICE 3E.2.

by JIM ROWE

I guess one of the reasons why this review has taken so long to appear is that Charles Hymowitz and his team over at Intusoft in the USA have kept on coming out with upgrades to the various programs in their IsSpice package. A number of times I had just become reasonably familiar with one new program and was ready to begin writing a review, when they suddenly announced the release of an upgrade to one of the *other* programs — so I would decide to wait 'just a bit longer' so that I could cover it as well...

This isn't the only reason for the delay, though, I have to admit. Another reason is that circuit simulation software is not exactly easy to review. In fact CAD software in general is quite tricky and demanding, when it comes to trying to give it an objective and thorough workout, and I think it's fair to say that simulation packages are among the most demanding of all. There's just so much involved in what they do, how they do it and how they're used, that it's almost impossible to do them justice unless you spend an inordinate amount of time putting them through their paces. And that's quite a tall order, when you have a lot of other things on your plate and don't have the luxury of being able to devote yourself to any one task for more than a few hours at a time!

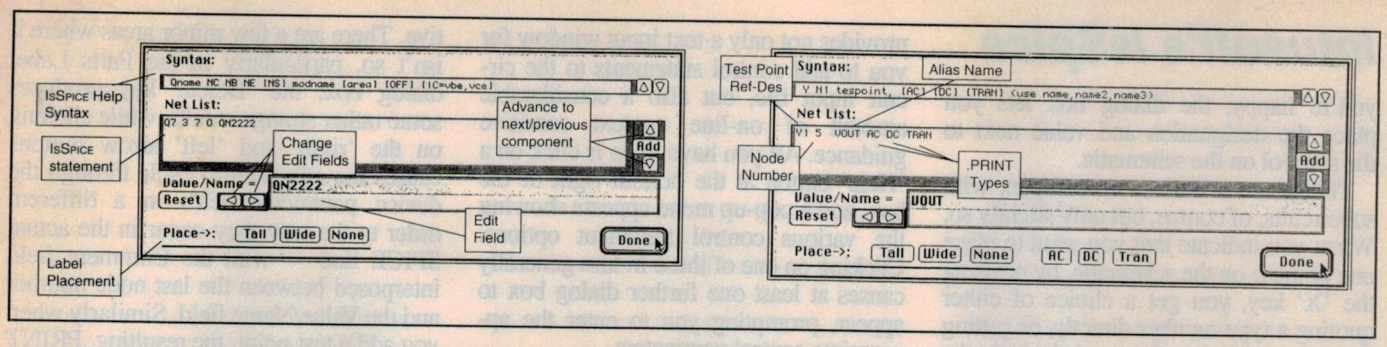
Yet another complication, in the case of Intusoft's package, is that the relatively rapid development of the various program upgrades has left a few 'rough edges' here and there, when it comes to things like actually installing the upgrades. More about this later on — for the moment I'd better skip the excuses and get into the actual review.



This is actually a screen shot taken from the Macintosh version of Intusoft's new SpiceNet schematic capture program, but it's very similar to the PC version. A pull-down menu provides a direct link to the simulator...

PreSpice 3.0

Let's start with *PreSpice 3.0*, the enhanced version of the pre-simulation processor. When I wrote the October 1991 article, you might recall that this had just been announced, but I had only been able to try out an early 'preview' Beta-test version. This had a fully functional version of the new text editor *IsEd*, which uses the same Windows-like graphical user interface that Intusoft had introduced with *IntuScope 3.11*, but only had the SPICE netlist version of the new expanded model library — not the matching and linked schematic models. All I could really do, with limited time available, was



At left is SpiceNet's Parts Label dialog box, showing the way it provides a sample of the appropriate Spice syntax for the component you are labelling. At right is the version of the same box used when you are labelling a circuit test point. In this case you can indicate whether you want to generate output for an AC, DC or transient analysis.

try out the new text editor with existing circuit files and verify that it was a big improvement over the old editor.

By the way *IsEd* is by no means just a standard text editor, even though superficially it looks rather similar to the *EDIT* program that comes with *MSDOS 5*. In reality it has a number of custom features which make it especially suited for simulation work — such as the ability to view and edit up to 20 netlists and library files at once, and to edit files as large as 3MB. It also includes a global search/replace function (both within the currently open file and in nominated files on disk), a context-sensitive online help system which includes a lot of information on SPICE syntax, the ability to select text between SPICE control characters and statements (like .SUBCKT and .ENDS), and pull-down menues which provide direct links to the other programs in the *IsSpice* package.

Needless to say, not long after I had written the October 1991 article the final version of *PreSpice 3.0* arrived, complete with the full array of expanded device model libraries and matching schematic symbols. This made it much easier to explore the libraries (which are now much expanded), and try them out.

There are now over 1000 device models included in the standard libraries that come with *PreSpice 3.0*, including many new JEDEC and European transistors and diodes — including zeners, varactors and Schottky diodes as well as signal and rectifier types. In addition there are models for power MOSFETs, IGBTs, SCRs, UJTs and PUTs, dual-gate MOSFETs, MOVs, switched-capacitor filters, fuses, thermionic valves, current feedback op-amps, transmission lines, non-linear magnetics, thermistors, transformers and so on.

In fact there are now so many models in the libraries that Intusoft supplies a 40-page A5 booklet listing of them all, to help you in finding (a) whether or not the model for a specific device is available, and (b) which library it resides in. The booklet also lists the op-amp models available in the optional Intusoft Op-Amp Library, which together with the optional RF Device Library brings the total number of available specific device models to well over 1600. (And that's from Intusoft alone; because *IsSpice* is fully SPICE compatible, many models available from device vendors can be used as well.)

As well as these specific device models, Intusoft also provides some 28 'generic' models, which are essentially special subcircuit models with 'blanks' to allow you to feed in the basic parameter data for any specific device, to produce a reasonably accurate model 'on the run'. And of course there's also the *SpiceMod* program, which we'll discuss shortly.

Needless to say *PreSpice 3.0* still provides the facilities to perform Monte Carlo analysis, parameter sweeping and circuit optimisation, in addition to simple 'fixed parameter' simulation.

SpiceNet 3.0

When I wrote the October 1991 article, Intusoft had advised that a completely updated version of their original *SpiceNet* schematic capture program would be available within a few months. The new *SpiceNet 3.0* did indeed arrive, at roughly the predicted time, and now uses the same Windows-like GUI as *IntuScope* and *IsEd*. This gives the complete suite a much more uniform and integrated look-and-feel, quite apart from the new GUI being rather more friendly and intuitive than the old one.

In basic function the new *SpiceNet* is similar to the original, in that it lets you quickly draw a schematic for the circuit to be simulated. Of course as before, this involves rather more than actually picking out symbols from library files and plunking them down on the screen, to create the schematic itself.

In this case, as well as drawing the schematic itself *SpiceNet* is also quietly assembling the corresponding SPICE input file — consisting of the circuit netlist plus the various control statements needed to tell the simulator what kind of analysis you want, etc.

Many modern schematic drawing packages produce a netlist, of course; although the list is generally intended for use by a PCB drawing package, and may or may not be in the correct format for SPICE. But it isn't usual for a general-purpose schematic drawing package to provide for the addition of simulator control statements. So here's where a program like *SpiceNet* really shines — and as you might imagine the new version is even more closely 'tuned' to the requirements of simulation than its predecessor.

In fact *SpiceNet 3.0* does make preparation of a schematic and SPICE input file quite a straightforward and efficient exercise. For placing symbols for passive components like resistors, capacitors and inductors, you simply press the 'R', 'C' or 'L' key and then manoevre the symbol to its correct position using the mouse and a few other keys (for orientation). Similarly active components like transistors and ICs are called up using either one or two keystrokes (e.g., 'Q' for an NPN bipolar transistor, '2Q' for a PNP, 'J' for an N-channel JFET, or 'X' for an IC or other subcircuit).

To connect everything together you simply press the 'W' key, and the mouse cursor becomes a small 'soldering iron' which draws lines for the connections. Node numbers appear automatically during the wiring up, and tend to be re-allocated dynamically as you extend or rearrange the schematic.

To label each of the components, you select them using the mouse. Double clicking on a selected device causes a Part Label dialog box to appear, and you are prompted to supply the component's designation and value, etc. For each type of device, the dialog box automatically provides an example of the appropriate correct SPICE syntax as a guide, plus the 'pro forma' entry for that component complete with its circuit node numbers. In many cases, all you have to do is provide the missing component value. When

you're happy, the dialog box lets you place the designation and value next to the symbol on the schematic.

Things are a little more complex with subcircuits, of course, but only slightly so. When you indicate that you want to place one of these on the schematic, by pressing the 'X' key, you get a choice of either quoting a type number directly, or getting the opportunity to 'browse' through the model libraries (for which there are matching symbols, as well).

If you choose to browse, a large dialog box appears; this offers a main menu of part types, a secondary menu of categories within many part types, and finally a tertiary menu of specific devices. Selecting a specific device causes a summary of its library references to appear, and you also get the opportunity to add the device to a 'Preferred Parts List' for faster subsequent retrieval and placement.

In addition to placing both passive and active components, you can also place things like ground symbols (allocated circuit node 0), voltage and current sources and both voltage and current test points. The latter are used to initiate '.PRINT' statements, to direct SPICE to produce the desired output data, and when you double click on a test point symbol to open the Part Label dialog box, you get the option of selecting AC, DC or TRANSient analysis.

After you've drawn the schematic and labelled all of the parts, sources and test points in this way, you can add the simulator control statements by opening the 'Edit Controls' dialog box. This provides not only a text input window for you to add control statements to the circuit input file, but also a considerable amount of on-line context sensitive guidance. All you have to do is click on a 'Help' button at the bottom right of the box, and a pop-up menu appears showing the various control statement options. Clicking on one of these in turn generally causes at least one further dialog box to appear, prompting you to enter the appropriate control parameters...

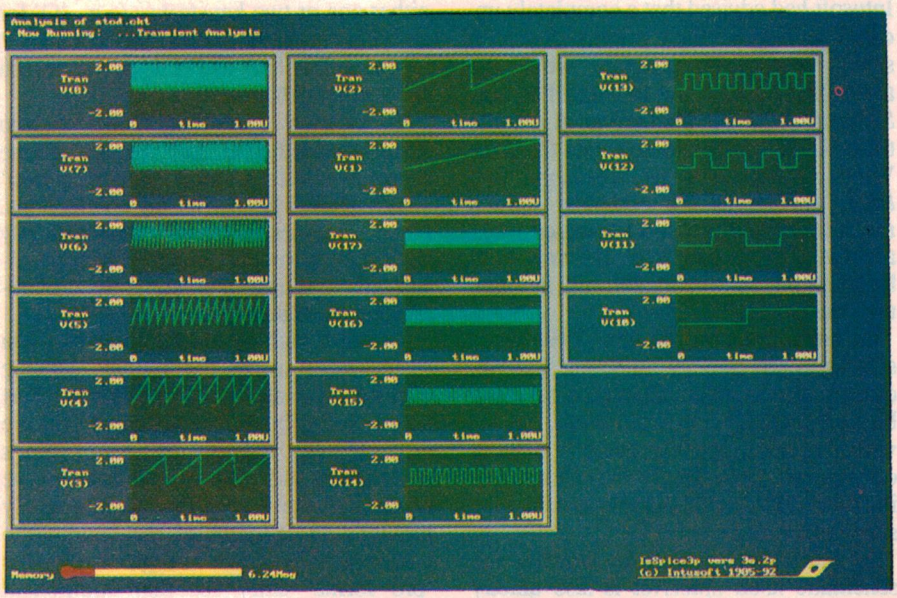
Then when you're fairly confident that your circuit file must be complete and ready for simulation, you can (a) save both the schematic and the input file to disk, with an appropriate name; (b) print out the schematic, for reference; and (c) click on the 'Actions' menu option at the top of the screen, to jump out into the simulator.

By the way, *SpiceNet 3.0* can print out your schematic directly to either Epson/IBM compatible 9-pin or 24-pin dot matrix printers, or HP LaserJet compatible lasers. In the latter case you can choose either 75, 150 or 300dpi resolution, with printout speed increasing noticeably with increased resolution. The program will also generate output in a range of graphics file formats, to allow porting into other packages: it supports TIFF, PIC, EPS (encapsulated Postscript), PCL, HPGL, DMPL and PRN formats. Surprisingly, in view of its support for EPS, you don't seem to be able to print directly to a Postscript printer — I would have thought this would now be easy to do.

In operation, I've found the new *SpiceNet 3.0* generally very friendly and intuitive. There are a few minor areas where it isn't so, particularly in the Parts Label dialog box: the 'Delete' key produces some rather strange results, while clicking on the 'right' and 'left' arrow buttons causes the edit field to cycle through the device parameter fields in a different order to the way they occur in the actual SPICE line — with the Comment field interposed between the last node number and the Value/Name field. Similarly when you add a test point, the resulting .PRINT statement *is* added automatically to the input file, but for some reason doesn't actually appear in either the Parts Label dialog or when you call up the Edit Controls dialog...

On the whole, though, the new *SpiceNet 3.0* is a very significant improvement over the original, and really lets you draw your circuit's schematic and prepare the corresponding SPICE input file both quickly and easily. If the people at Intusoft fix those little nigglies noted above, you couldn't wish for a more efficient way of preparing circuits for simulation by *IsSpice* or any other truly SPICE-compatible simulator.

Incidentally, the version of *SpiceNet 3.0* I first received turned out to have a minor bug in the video driver area: when you opened the Parts Label dialog box and went to place the label on the schematic, it seemed to get 'lost' and also left part of the dialog box behind when you returned to the schematic. However this was fixed in the latest modified version, which carries the number 3.02D12.



As well as being much faster than earlier versions, the new IsSpice 3 simulator also provides plots of your chosen variables while the simulation is being performed. This allows you to abort if things are not going as you'd expected...

SpiceMod 2.1

When I wrote the October 1991 article, Intusoft's *SpiceMod* device modelling 'spreadsheet' program could help you produce models for many kinds of diodes, bipolar transistors or 'BJTs', power BJTs, Darlington transistors, JFETs, MOSFETs, and two different levels of power MOSFET. Since then version 2.1 of the program has been released, with an extended range of device modelling facilities plus an enhanced on-line help facility.

SpiceMod 2.1 now lets you produce models for zener diodes, quite separately from other signal and rectifier diodes. It also provides modelling for two additional subcircuit devices: SCRs (both low and high power, GTO's and sensitive gate types), and IGBTs (insulated-gate bipolar junction power transistors).

As before, the new *SpiceMod* works rather like a familiar spreadsheet program. You are provided with a range of cells, into which you enter a device's behaviour parameters from the manufacturer's data. As you do so, the program calculates the corresponding

parameters in the SPICE model. With the simpler devices like diodes, BJTs, JFETs and MOSFETs, the SPICE model is visible at the bottom of the entry screen, and you can see the parameters changing as you key in the data; with the more complex devices the model isn't directly visible, but can be viewed at any point on an alternative screen, by pressing the F2 key.

With all of the devices, the new *SpiceMod* still offers the very nice 'expert system' feature of the original version — whereby it can make an intelligent estimate regarding many of the device model parameters, if data on some aspects of its behaviour is not available from the manufacturer's data (which is often the case). There's a certain 'minimum data requirement' for each device, of course, but provided that you can provide this data at least, *SpiceMod* can generate a SPICE model with reasonably realistic DC, AC and transient behaviour. If you can find and supply even more of the device's data, the model will be that much more accurate.

For example with zeners, the minimum data requirement is zener voltage and power rating. *SpiceMod* can make reasonable estimates of everything else it needs for the SPICE model from these, if it has to. Similarly for a BJT the minimum data requirement is maximum V_{CEO} and maximum Ic.

When you have created a device model, it can be saved either as a separate file or appended to a library of other created models in *SpiceMod*'s working directory. The model or library file can also be retrieved separately, for viewing and/or editing (it's a standard ASCII text file).

Needless to say *SpiceMod 2.1* with its expanded device modelling repertoire and enhanced help facilities is rather more useful than its predecessor. However in terms of the user interface, it's still a little primitive compared to the rest of the *IsSpice* package. Unlike the other programs it doesn't respond to the mouse at all, but is purely keyboard driven. This is a little surprising, because even the ICAPS shell (which is the only other part not as yet provided with a graphical GUI) responds to the mouse for basic menu selection.

There's also still quite a rigmarole involved in copying models you've created with *SpiceMod* over into the working directory used by the other programs in the package for their models and libraries, and then linking them to the appropriate schematic symbols so you can call them up in the usual way via *SpiceNet*. As well as copying them over to the working directory, you have to run various utilities to update *SpiceNet*'s model indexing files.

To my way of thinking there's still something missing from *SpiceMod 2.1*, too: ideally you'd be able to display and print out plots of the performance of the resulting SPICE model, to check its accuracy against the actual performance. This facility is provided by its equivalent program in the *PSPICE* package, for example (*PARTS.EXE*).

At present you still have to do this kind of testing yourself, after porting the model over into the rest of the package. This involves preparing a suitable test circuit using *SpiceNet*, with the necessary test points; running it through the simulator; and then plotting out the results using *IntuScope*. I suppose I'm getting a bit spoilt and greedy, but it would be nice if *SpiceMod* had this kind of facility built in, in pre-digested form for each main device category...

I don't think this would necessarily jack up the price of *SpiceMod* all that much, because I suspect it could simply enter your new model into an appropriate 'precooked' test circuit file, and then call the simulator and *IntuScope* via a batch file, which ultimately returned you back to *SpiceMod* itself. Hopefully the people at Intusoft might be able to look into this, and if it's feasible provide it on the next upgrade.

Otherwise, and despite the above criticism, *SpiceMod 2.1* is a definite improvement on its predecessor and quite a friendly tool for making your own models for additional devices. If Intusoft can improve the points I've noted, it will then be excellent.

Mind you, it'd be nice if Intusoft *also* gave it the facility to let you quickly create voltage sources for 'special' testing signals (like a composite video signal, or a carrier with AM or FM). Then we'd *really* be able to use it for more real-world simulation jobs...

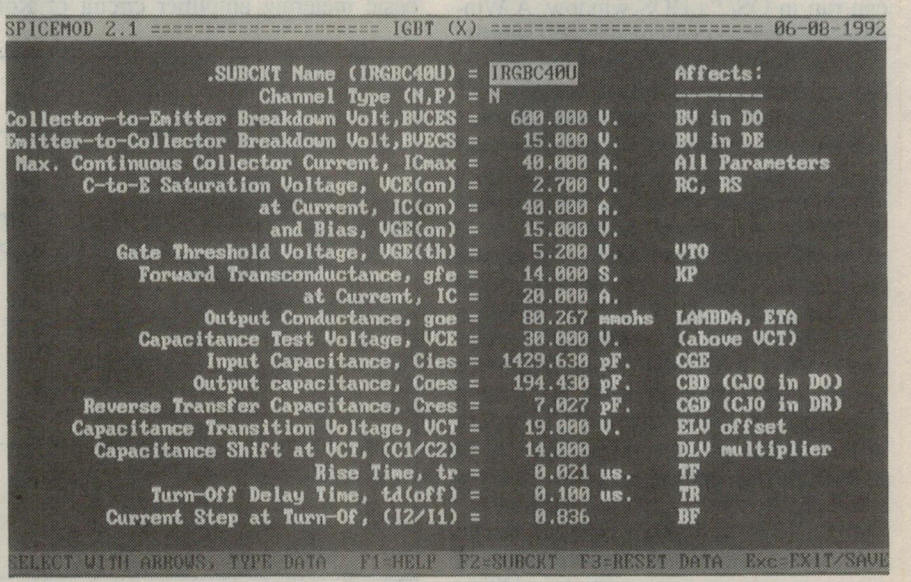
IsSpice 3

And now we turn to the Intusoft upgrade which is probably the most significant of them all: the release, late last year of *IsSpice 3*, the new simulation engine itself.

Virtually all previous SPICE simulators from both Intusoft and the other commercial vendors have been based on SPICE 2G.6, the 'Mark 2' mainframe version of the original simulator developed at the Berkeley campus of the University of California about 20 years ago. Like Intusoft, most of the commercial vendors have put their efforts into providing this basic simulating engine with a more friendly user interface (which it certainly needed).

However with *IsSpice 3*, Intusoft has produced the first commercial simulator based completely on the fully current 'Mark 3' Berkeley version, SPICE 3E.2. In fact they've gone further, correcting some of the known bugs in SPICE 3E.2 and adding various enhancements — including full syntax compatibility with the earlier SPICE 2G.6, so that files prepared for earlier engines will run without problems. This includes a built-in translator for the 'dependant source polynomial syntax' used by 2G.6, converting it automatically into the 'B element' nonlinear dependant source format recognised by 3E.2.

Perhaps the most obvious enhance-



A sample of one of the new modelling screens provided by Intusoft's device modelling spreadsheet program, SpiceMod 2.1. As you can see, this screen is the one for modelling an IGBT or insulated-gate bipolar power transistor.

ment, though, is that *IsSpice 3* is the first SPICE simulator able to display nominated plots and waveforms on the screen of the PC, as the simulation is running. As well as making it much more 'communicative' than the earlier versions (which have generally provided only a largely blank screen, with small status messages that were often almost unreadable, because they changed so rapidly), this also allows you to monitor the simulation run and if necessary abort it if things have become 'stuck' — or you can see that your hoped-for result isn't going to happen, and there's no point in waiting for the normal end of the run.

You might think that this real-time plotting facility would slow down the actual simulation to an unacceptable extent — after all, a simulator involves the CPU in an enormous amount of number-crunching already, without having to draw pretty pictures along the way. However Intusoft says that in fact there has been a reduction in simulation speed by only 5%, due to the way that *IsSpice 3* stores its nodal data and the way they've optimised the graphics routines.

In any case the new simulator runs considerably faster than all previous versions, thanks to having been developed using a 32-bit C/C++ compiler and a new DOS extender. By the way this means that the DOS version only runs on 386/486 PCs, but there's also a version for the Macintosh (including Quadra models) and the NEC 98 series. The DOS version is compatible with DOS 3.3 and later versions, Windows 3.1 (Himem compatible) and can run in OS/2's DOS window. A Windows-NT version will be released shortly.

Other important features of the new *IsSpice 3* include the ability to perform AC, DC, transient, noise, distortion, Fourier, pole-zero, temperature, sensitivity *and* mixed-mode analyses on virtually any circuit operating from DC through into the microwave region; the ability to set a different temperature for a particular component (2G.6 only allowed global temperature changes); built-in Boolean logic expressions for digital logic simulation (with new .OPTIONS parameters for global control of logic levels); new analog behavioural modelling features (including in-line equations using algebraic, trig or transcendental operators, node voltages and voltage source currents, and an IF-THEN-ELSE function); user-adjustable memory allocation and control; improved convergence properties (with the addition of Gmin/source stepping algorithms); and many additional built-in device models, including three MOSFETs (BSIM 1 and 2, Level 6), MESFET (based on the Statz model), lossy transmission lines (including RC, LC, RG and RLC), distributed lumped RC transmission line, and voltage and current controlled switches.

In short, Intusoft's VP Charles Hymowitz has a lot of justification when he claims that "*IsSpice 3* is a quantum leap over SPICE 2G versions. It truly makes the latest state of the art simulation capabilities affordable and accessible, for every engineer".

Intusoft very kindly sent me a sample copy of the new engine, allowing me to try it out for myself. The machine I have been using for all simulation work during the last 18 months or so is based on a standard 486DX running at 33MHz, with a total of 8MB of RAM and a fast 220MB hard disk, and this was the one I used for the comparison with the earlier engines.

Many of the circuits I've simulated to date have been relatively simple, mainly involving AC analyses of fairly modest amplifier or filter stages. Because these simulations have generally run quite fast on the 486 even with Intusoft's original *IsSpice 1.41*, I've actually been using until *IsSpice 3* arrived — there hadn't seemed much reason to upgrade to the faster *IsSpice/286* or *IsSpice/386* versions.

Inevitably this meant that *IsSpice 3* would be a big step forward, in speed alone, compared to the version I'd been using. It also meant that to make the comparison meaningful, I had to try simulating a rather more complex circuit — one that would take at least *IsSpice 1.41* a significant time to run, on my 486.

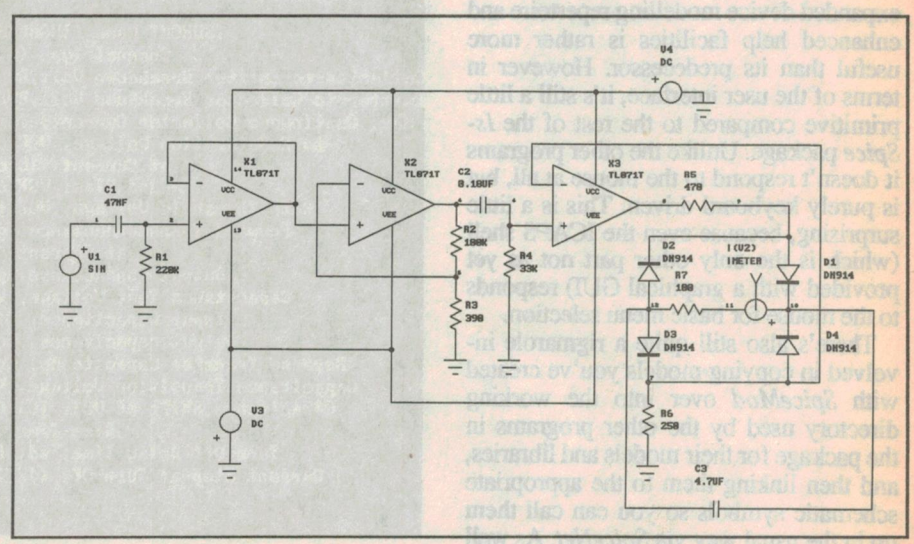
After a few trials, I ended up using the basic metering amplifier circuit of Rob Evans' new Noise and Distortion Meter, as published in the May and June issues, and using a transient analysis which plotted the meter current against an instantaneous AC input voltage of 50Hz. It turned out that this took a total of 73 seconds to simulate with *IsSpice 1.41* — not counting pre-simulation processing by *PreSpice*, but including the time to load the simulator itself into memory.

When I installed *IsSpice 3* (of which more soon!) and tried this instead, the same simulation took a total of 13 seconds — again including program loading time, but not pre-simulation processing. This corresponds to a speedup of 5.6 times, which is particularly impressive considering that the new engine gives you real-time plotting as well...

Actually if you subtract the program loading time as well, the speedup is even more impressive — and in many ways more accurate, since the time to load any program is more a function of your hard disk, than of the program itself. Since the time to load either program was around four and six seconds respectively (*IsSpice 3* is about twice the size), this means that the true simulation time for the test circuit was about 69 seconds for *IsSpice 1.41* and seven seconds for *IsSpice 3* — giving a speedup factor of about 9.8 times!

I've tried out *IsSpice 3* on a few other circuits since then, and the degree of improvement seems to be generally of this order. So Intusoft does indeed seem to have achieved a dramatic step forward with *IsSpice 3*; as well as offer many important new features compared with the earlier SPICE 2G.6 versions, it's also much faster...

Incidentally when they discovered that



This is the circuit we used to check the speed performance of the new IsSpice 3 simulating engine compared with its predecessors, using a transient simulation. It's basically the metering section of our new Noise and Distortion Meter.

I had still been using *IsSpice 1.41* before trying out the new engine, Intusoft suggested that before installing *IsSpice 3* I should at least try out the intermediate *IsSpice/386* version, for a further comparison. To help me do this they arranged for me to get a sample copy of *IsSpice/386* from local distributor Peter Stein, of ME Technologies. Which was very nice, of course — except that when I tried installing it, there were complications which caused further delays. This leads me into the final phase of this review, dealing with my remaining gripes about the current Intusoft package as a whole.

Weak areas

Now don't get me wrong. On the whole, after using the various upgraded elements of the *IsSpice* package for periods ranging from a year down to a month or two, I am tremendously impressed with Intusoft's achievements. Despite the criticisms alread noted, and even those I'm about to make, the complete package is much easier to use than previous versions and is now an extremely powerful circuit design tool.

In fact this achievement is almost mind boggling when you consider the simulation horsepower that this package provides, on a standard PC and for the very reasonably price involved (see later). Only a few years ago you would have needed megabucks and a very large and fast mainframe computer to achieve anything like this order of performance.

Nor can I fault the kind of support that is provided for the package, by both Intusoft in the USA and its local distributor Peter Stein. Every time I've struck a problem, they've gone out of their way to help.

But there *are* still a number of irritating aspects of the package, minor in themselves but nonetheless capable of causing incredible frustration when you're using it.

Many of these hassles are associated with the SETUP program used to install both the suite of programs as a whole (if you buy it as one of the integrated ICAP/X packages), or the individual programs and upgrades.

Strictly I should say 'SETUP programs', plural, because there have been a number of versions of this released along the way, and many of these seem to be sufficiently different that they can be incompatible with some versions of the main package programs...

Compounding the hassles caused by different versions of SETUP is the fact that Intusoft has also used no less than three different hard disk directory configurations along the way, and currently seems to have arranged SETUP to favour a 'default installation' that is significantly messier and more arcane than the nominated 'alternate installation' — which uses a neat 'Append /X' line in the main batch file calling the ICAPS shell, rather than a whopping great set of additions to the PATH line in your AUTOEXEC.BAT file. The 'alternate' setup also avoids the need for an ISLIB environment variable in the AUTOEXEC.BAT file, so it's a mystery why Intusoft hasn't made it the default one.

It turned out to be this aspect that caused many of my own hassles and delays, in trying to install first *IsSpice/386* and then *IsSpice 3*. I had originally elected to use the simpler 'alternate' configuration, but then during the installation of the engine upgrades (which was some months later) I didn't notice that SETUP was not only installing the new engine, but also automatically replacing both the ICAPS shell and its calling batch file — the new version of which was set up for the 'default' configuration...

As a result, when I tried to run everything after installing the new engine, ICAPS suddenly couldn't find *any* of the other programs in the package! It was only when this happened with *IsSpice 3* as well as *IsSpice/386*, that I finally worked out what was happening.

There are actually quite a few other little hassles, of the same type. For some reason, after installing *PreSpice* you have to open up the batch files used to call the *IsEd* editor (either before or after simulation), and modify these files by adding PATH statements to the end of their first lines. I can't for the life of me understand why these couldn't have been done by Intusoft beforehand, to save us the trouble...

Similarly after you install the optional op-amp or RF device model libraries (which use a different INSTALL program of their own), you have to fire up manually a utility called *SINDEX.EXE*, which updates the index and symbol files used by *SpiceNet* to find the new models when you want them. Again it should surely have been possible for Intusoft to have this utility called automatically at the end of their INSTALL program, to save the user having to do it manually.

In short, then, the overall *IsSpice* package still seems to have quite a few silly little 'rough edges' — which are all the more irritating (even infuriating at times) simply because the main programs in the package are so darn GOOD!

I know it's easy to criticise, and Charles Hymowitz and his team have without a doubt already achieved great things with this package. But at present I'm afraid it is weak in the area of ease of installation and upgrading in particular, and in this respect doesn't compare with a modern package like say Microsoft's *Windows 3.1*. If the Intusoft team can just put a little more effort into bringing this aspect of the package up to the same level as the rest, they'll make it truly outstanding.

(By the way, I did finally get *IsSpice/386* going, after discovering the hard way another hassle: unlike either *IsSpice 1.41* or the new *IsSpice 3*, it won't run if your system is using the HIMEM.SYS upper memory manager. Once I temporarily disabled HIMEM.SYS, it ran fine — and clocked up a simulation time of 16 seconds for the test circuit. That's 4.3 times faster than *IsSpice 1.41*, and only a little under half the speed of *IsSpice 3* — although when you've used the latter, you'd never want to use its predecessors!)

The bottom line

What does all of this upgraded simulator horsepower cost? The prices are surprisingly reasonable, and are certainly lower than any competing products. Purchased separately, the new *PreSpice 3.0* program costs $458.00; *SpiceNet 3.0* costs $741.00; *SpiceMod 2.1* costs $416.00; *IntuScope 3.11* costs $541.00; and the new *IsSpice 3* engine costs $1158.00. However upgrades from earlier versions of all of these packages are available at significantly lower prices, and the programs also work out considerably cheaper if you buy them in complete packages.

For example the top of the line ICAP/4 package, which comprises *SpiceNet 3.0*, *PreSpice 3.0* and *IntuScope 3.11* together with *IsSpice 3*, costs only $2625 — a saving of $273 over their prices when purchased separately, and around one quarter of the cost of any comparable PC-based SPICE simulating package. If purchased with a package like ICAP/4, the *SpiceMod 2.1* program is also discounted to $333.00. The optional model libraries are also very reasonably priced, at $159 for the Deluxe Op Amp Models library (875 models) and $165 for the RF Devices library.

The prices for Macintosh versions of the programs are quite comparable with the PC versions, and again very reasonable for this kind of software.

Further information on any of the Intusoft packages is available from Peter Stein of ME Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2254; fax (065) 50 2341. My grateful thanks to Peter Stein, and both Charles Hymowitz and Matthew Archambault of Intusoft, for their help in the preparation of this review. ❖

Special feature:

Data Acquisition and Computer Control products

Data acquisition analysis software

HEM Data Corporation has released its 'Snap-Master for Windows'. Snap-Master is a new generation of data acquisition and analysis software for engineers and scientists, designed to take full advantage of the power of Microsoft Windows.

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It is organised in three modules: data acquisition, general analysis, and frequency analysis. Each operates as a stand alone package, or together for integrated data acquisition and analysis.

The Data Acquisition module integrates data acquisition, high speed data streaming to disk, near real-time plotting, storage and data retrieval. The software will operate to the maximum speed of your A/D hardware. It will acquire and stream data to disk from multiple input sources simultaneously, pace acquisition with an internal or external clock, and synchronise the start of data sampling with a trigger.

The General Analysis module provides time domain analysis, display, storage and retrieval. Analysis can either be during testing or post acquisition. The software will allow you to construct simple or complex equations, and combine and analyse data taken at different sample rates.

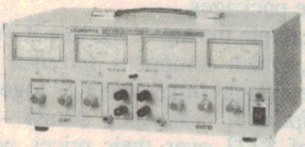
The Frequency Analysis module converts time domain data to the frequency domain for analysis, display, storage and retrieval. It allows for FFT, power spectrum, coherence and transfer function calculations; phase and magnitude calculations and digital filtering using both FIR (finite impulse response) and IIR (infinite impulse response) techniques.

For further information circle 201 on the reader service coupon or contact Interworld Electronics & Computer Industries, 1G Eskay Road, Oakleigh South 3167; phone (03) 563 7066, fax 563 7337.

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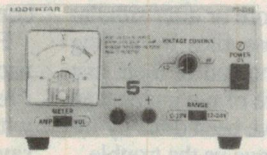


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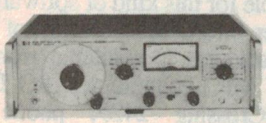
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For further information circle 202 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011, fax 560 1804.

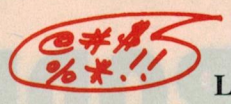
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The board also provides a 20-point screw-terminal board and a flat capable to make analog input wiring easier. Resistors, capacitors, and other passive components can be mounted on it to create filters, attenuators, or other signal-conditioning circuits.

For further information circle 220 on the reader service coupon or contact Priority Electronics, 5/23 Melrose Street, Sandringham 3191; phone (03) 521 0266. ❖



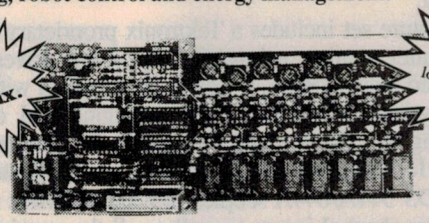
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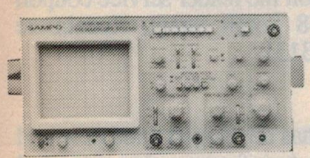
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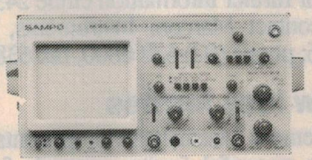


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NEW PRODUCTS

500MHz DSO's have colour displays

Tektronix Australia has announced the addition of two more digital oscilloscopes to its popular TDS series. The new TDS 544A and TDS 644A scopes include a colour monitor and extended capabilities, which greatly enhance the scopes' graphical user interface (GUI), acquisition process, triggering selection and analysis power.

The new feature set includes a Tektronix proprietary NuColor full colour shutter monitor, a 1.44MB floppy disk drives that extends embedded mass storage, a video trigger option with HDTV triggering, segmented memory, FFT averaging and expanded template testing to include math waveforms. The enhanced features are ideal for advanced research and design applications.

The new TDS 544A/644A scopies provide 500MHz real-time bandwidth, four channel input, as well as all the acquisition and advanced triggering modes and GUI found in the TDS 540/640 scopes. Like the TDS 540, the TDS 544A offers 1GS/s maximum sample rate, and an optional record length of 50,000 points-per-channel (15,000 points standard). The TDS 644A has the same four-channel, 2GS/s sample rate found in the TDS 640.

The colour display improves productivity by simplifying the recognition of waveforms on cluttered displays, and provides colour grading for distinguishing jitter metastability. It uses a proprietary liquid crystal shutter system attached to the front on a monochrome CRT. The NuColor display provides colour purity, convergence and reliability far exceeding traditional shadow mask capabilities.

For further information circle 270 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066, fax 888 0125.

Micro relay

Omron has released its G6N micro relay. This DPDT relay is only 11 x 15mm in size, and has a contact rating of 2A, with a dielectric withstanding voltage of 1500V AC between coil and contact. For further information circle 242 on the reader service coupon or contact ACD, PO Box 139, Bayswater 3153; phone (03) 762 7644, fax 762 5446.

Fast working radio test set

Marconi Instruments' new high performance radio communications test set has been readily accepted by the Australian market with a significant number of orders from OTC, Telecom and the NSW Police.

The new model 2965 offers superior performance by incorporating AF and RF signal generators, modulation analyser, audio power meter and distortion analyser, audio and RF spectrum analyers, RF frequency and power meters and a full feature DVM.

One of the attractive features of the new 2965 is its measurement speed. For a comprehensive set of radio tests, it boasts a test routine time of only 27 seconds. This has been achieved thanks to an advanced multi-processing architecture incorporating eight independent microprocessors. With the advent of digital radio communications such as GSM, the 2965 has been specifically designed with a low cost upgrade path available.

For further information circle 245 on the reader service coupon or contact Marconi Instruments, 38 South Street, Rydalmere 2116; phone (02) 638 0800, fax 638 3131.

Low loss ferrites

Siemens Matsushita Components has developed three new and more powerful ferrite materials for transformers that are used primarily in switched-mode power supply units.

The outstanding property of the new N97 ferrite is its low core power loss which, at a figure of 70mW/g under typical operating conditions (100kHz, 200mT, 100°C), is approximately 18% less than comparable materials.

The ferrite N62 has a high saturation inductance of 510mT (at 2kHz, 1200A/m, 20°C). It gives better DC biasing compared with the previous material; not until current intensity reaches values 10% higher does a 20% loss of inductance occur. The new material has an initial permeability of 1900 and is suitable for frequencies up to 300kHz.

Ferrite material N59 has been developed specifically for high frequencies up to 1MHz. Under conditions of 1MHz, 50mT and 100°C, it exhibits a low core power loss of only 110mW/g. Saturation occurs at 480mT (20°C) and the initial permeability is 900.

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Of course, it goes without saying that the Navy trains its technicians to an extremely high standard. And even expects them to undertake on-going technical and management training. (All of which can contribute to earning civil accreditation and a good job upon leaving the Service.)

If all this sounds more like a challenge than a chore, then a technical career in the Navy can take you a long way, and even result in you becoming an Officer.

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NGE6.FPC.43

Silicon Valley NEWSLETTER



Young to head Smart Valley project

Six months after retiring as president of Hewlett-Packard, John Young has found a new mission, as the executive will become chairman of Smart Valley, one of five subsidiaries of the recently formed Joint Venture Silicon Valley consortium.

Smart Valley was formed to coordinate a broad effort to link all aspects of Silicon Valley, including businesses, hospitals, government and educational institutions into a single optical-based high speed data and communications network.

The creation of the data network was the focal point of Joint Venture Silicon Valley, which aims to revitalise Silicon Valley as the premier breeding ground for high technology industries.

Young was chosen for the position in part because of his close ties to the Clinton Administration, in particular as a member of a group of business executives who is studying the Clinton Administration's proposals on building a US-wide fibre optic based data 'super highway' network.

"Implementing some demonstration projects in Silicon Valley may influence what happens at the national level and tie both ends together," Young said.

Young said his first priority is to find a president for Smart Valley and to start seeking the tens of millions of dollars in funds that will be necessary to implement the Smart Valley program.

Lucas, SG to build better special effects

If special effects in recent blockbuster movies like *Terminator II* weren't eye-popping enough, future Hollywood productions may see an escalation of special effects — if movie mogul George Lucas and Silicon Graphics get their way.

Lucas announced his industrial Light & Magic (ILM) special effects company has formed a joint venture with workstations vendor Silicon Graphics, to develop advanced hardware and software products that will revolutionise special effects creation and movie editing.

The joint venture between Silicon Graphics and ILM, which has won a stunning nine Special Effects Oscars in 15 years, will be called 'JEDI' (Joint Environment for Digital Imaging). It aims to develop technology that will allow movie directors to shift from the traditional photographic process to an all-digital movie production and editing process.

In reality this means that as soon as a scene is shot, the images will be entered digitally into a computer memory bank from which the director can electronically edit the scene, eliminating the need to retake an entire scene when minor changes or improvements are needed or desired.

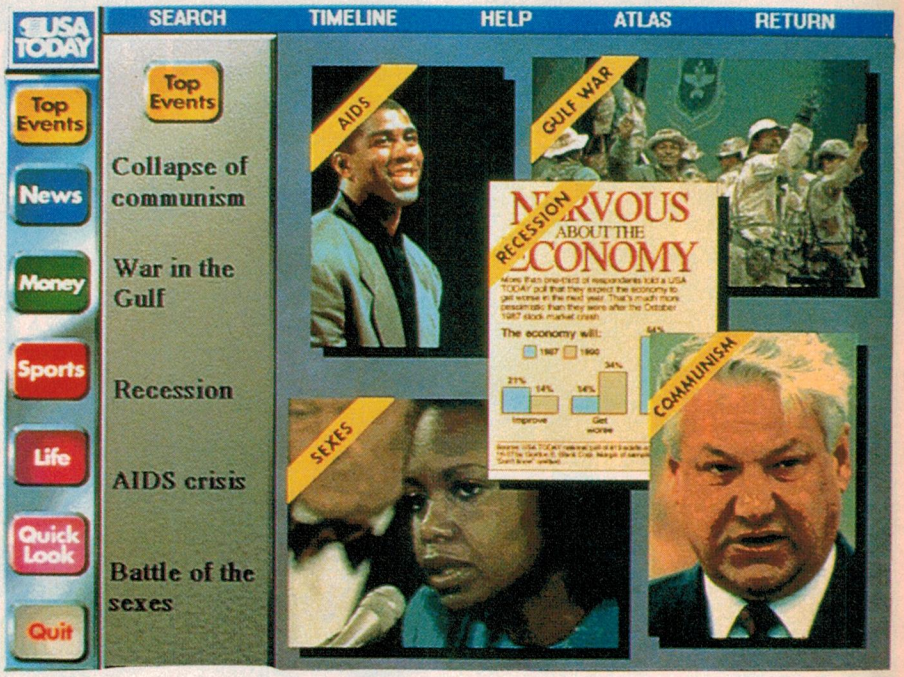
For its part, Silicon Graphics has been deeply entrenched into the Hollywood movie scene for years. It has worked closely with Lucas' special effects company on the special effects for *Terminator II* and other movies.

"My main interest is the interface between human imagination and the hard reality of creating an image," said Lucas in a rare public appreance at the announcement of JEDI.

At JEDI, engineers from both companies will be working with some 70 top of the line Silicon Graphics workstations and servers. They will also build a high speed network to link ILM's headquarters near San Francisco with the company's clients in Hollywood and elsewhere.

Already an early implementation of the network is currently being used to send digital images of the upcoming movie *Jurassic Park* to director Steven Spielberg in Poland, where the film maker is currently on location for yet another film. Using the network, Spielberg is able to take part in the final edting of *Jurassic Park*, just as if he was in his production facility in Hollywood.

One of the major objectives of the JEDI venture, Lucas explained, was to drastically cut the cost of creating special ef-



One of the highlights of a trade show held recently in San Jose by the US 'multi-media' industry was the release by Compton of what is claimed to be the first truly interactive multi-media encyclopedia for the Apple Macintosh. Featuring a new software technology called 'Virtual Workspace', the encyclopedia allows users to organise the information they retrieve in the way that best suits their needs, on a virtual workspace up to 25 times the screen size. Compton has also launched the 'Compleat Beatles' film on a CD-I disc.

fects. That in turn, will enable movie makers to incorporate far more eye-popping gimmicks into their productions.

Pentagon invests in 256MB memory circuit

The Clinton Administration has announced it will allow the Pentagon to invest US$5 million in a chip research project that aims to produce memory chips capable of storing 256 megabits of information.

The project will be undertaken by Advanced Technology Materials, a tiny company. IBM, Texas Instruments and Micron Technology will also take part in the research.

The federal grants will be furnished through the Defense Advanced Research Projects Agency (DARPA). In the past DARPA has tried to invest in various high-tech development programs, but those efforts were blocked by President Bush — who opposed investing in projects that did not serve a strictly military purpose.

US chip market breaks more records

The first quarter of 1993 is one Intel will want to remember. The company's sales soared past the US$2 billion mark and earnings set yet another record, as they topped the half-billion mark for the second consecutive quarter.

While Intel continues to dominate the microprocessor market, future quarters are unlikely to be as superb as this last period. Sales hit US$2.02 billion, up a whopping 63% over the $1.24 billion in revenues during the same quarter last year. Profits, meanwhile, rose a stunning 197% from US$184 million to $548 million.

"It took us 22 years to get to US$1 billion per quarter in sales, and less than three quarters to get to $2 billion," said a jubilant president Andy Grove.

As for the future of Intel's financial performance, analyst opinions are mixed. One group believes Intel's growth could continue virtually unabated for another year or more as Pentium revenues will be getting into gear soon. They point out that of the 100 million PCs sold to date, more than half are built around 286 or older processors. With the growing popularity of power hungry software such as Windows 3.1, there remains a vast market of users that will be upgrading to 386 or 486 machines. Still others will want to add 586 power to their company's PC capabilities.

On the pessimistic side, some analysts see problems ahead, including a slump in PC sales following two years of price wars, which may have all but exhausted the pool of potential new and existing PC buyers. They point to problems in the disk drive market where prices for disk drives are plunging and demand slumping. If PC makers aren't adding to their disk drive inventories, it could mean the end of the PC sales boom has come into focus. Orders for Intel processors may soon see a similar slump.

In addition, new competition in the lucrative 486 market is just around the corner, as AMD remains committed to start selling a 486 clone in June. If AMD's success in the 386 market is any measure of what will happen to the 486 market, Intel stands to lose a huge chunk of the 486 market over a relatively short period.

TCI to offer 500 cable channels

If 65 channels weren't enough, the 14 million US-based subscribers to the Tele-Communications Inc (TCI) cable newtwork will soon have the availability of more than 500 channels.

TCI has formally announced a US$2 billion 'infostructure' program to replace its existing network of thousands of miles worth of copper-based cable with optical cables. The conversion is expected to be completed by 1996.

TCI officials said that besides vastly more conventional television channels, their optical network will allow consumers and businesses to gain access to a broad variety of new interactive channels to allow for electronic banking, home shopping, video phone calls, and access to digital data and entertainment libraries.

TCI said the Infostruction will give people far more control over what they can watch and will vastly expand the functionality of television and computer appliances. Users can program their system to deliver custom tailored 'newspapers', covering only subjects the users are interested in.

US$1 billion 686 plant goes to New Mexico

In a move that came as a disappointment, but not as a big suprise to much of Silicon Valley, Intel has chosen the small community of Rio Ranch outside Albuquerque, New Mexico, as the site of its new massive US$1 billion 'Fab 11' wafer fab facility.

The facility could employ as many as 1000 people when brought to full production level. The facility will produce Intel's 686 chip, currently under development under the project title 'P6". That chip will contain between five and six million transistors, almost double the three million found on the new Pentium chip.

Among the many contenders for the plant was a site in Folsom, near Sacramento, where Intel has considerable production facilities.

Intel said the New Mexico site was chosen for several key advantages. For one, another nearby Intel plant has proven to be its most productive facility. But more important, New Mexico has approved a US$1 billion bond measure to help Intel finance the construction of the facility, without having to dig into its own coffers or find outside funding at high interest rates. Part of the New Mexico money will also be used by Intel to train prospective employees of the plant.

While many had expected Intel to seek a site outside California, the announcement was labelled as yet another defeat for California, which has lost almost every major high-tech venture it has bid on in the past decade — including Sematech and the Supercollider.

AMD to boost flash output

After seeing its sales of flash memory chips increase 50% to US$39 million, Advanced Micro Devices said it is further boosting production of the chips and also said it plans to begin selling flash-based memory cards in the near future.

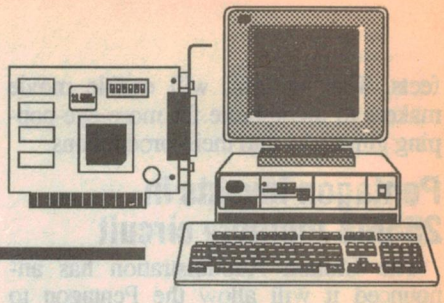
Currently, AMD controls 18% of the flash memory market, making it the second largest flash producer after Intel which still controls the bulk of the flash market. But AMD said it wants to quickly boost its share to 40%, which would mean increasing its flash sales from just US$46 million in all of 1992 to $225 million this year. Dataquest has estimated that flash sales will double this year, from US$258 million to just ove $500 million. By 1996 sales could top $2.6 billion.

Analysts said the AMD moves makes a lot of sense. Market share is a critical factor in a rapidly expanding market. AMD has teamed up with a Japanese partner (Fujitsu) to build a US$600 million Flash facility. It will need to maintain a sizable share of the flash market if it wants that plant to achieve a high production rate after it comes on line.

In the meantime, AMD said that in order to boost flash production, it will reduce output of its less profitable EPROM lines to make room for more flash wafer output.

The EPROM production will be shifted to outside contract manufacturing facilities. AMD will also buy some flash chips from Fujitsu for resale to its US customers. ❖

Computer News and New Products

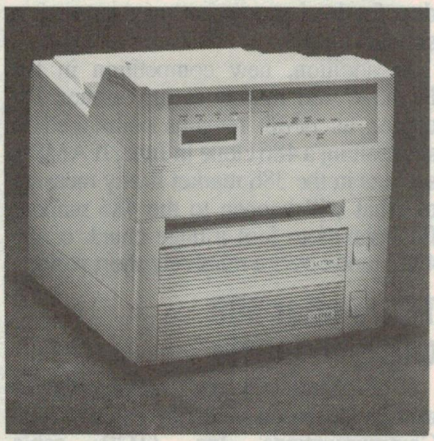


Low cost 8ppm laser printer

The Dataproducts LZR 855 laser printer targets PC users who require PCL-5 Page Description Language (PDL) for internal scalable fonts, in a low cost desktop personal package. The LZR 855 is specifically designed for these users, but with expansion in mind for PostScript and network connections.

The LZR 855 is an 8ppm printer with an advanced AMD 29005 RISC processor and 32-bit 'triple bus' architecture. It features 600 x 600dpi 'marking' engine that allows the printer to produce 360,000 dots per square inch.

The RISC processor rasterises at 300 x 300dpi and uses High Resolution Technology (HRT) to convert this information to a 600dpi bitmap image. This advanced intelligent controller also examines the surrounding dots and decides the best spread of dots to produce super fine curves, lines and grey scales. The LAZ 855 incorporates an ultra-fine toner (eight microns), resulting in excellent quality at a low cost.



The standard configuration of the LZR 855 is: 1MB memory, a parallel interface and PCL5 controller — making it ideal for the PC personal laser market. Standard resident fonts are 14 bitmapped and 13 outline (scalable fonts), plus provision for two optional font cards that support a wide range of HP compatible bitmapped and outline fonts.

It easily upgrades to PostScript, with optional serial and AppleTalk connections, and emulation auto-sensing. TCP/IP, Novel and IBM Twinax/Coax network connectivity are also available, as an option. Total memory available on the printer is 9MB and the PostScript option adds 35 type 1 compatible fonts.

For further information circle 169 on the reader service coupon or contact Dataproducts, 10 Rodborough Road, Frenchs Forest 2086; phone (02) 451 3533, fax 975 1652.

Teletext pack for PCs

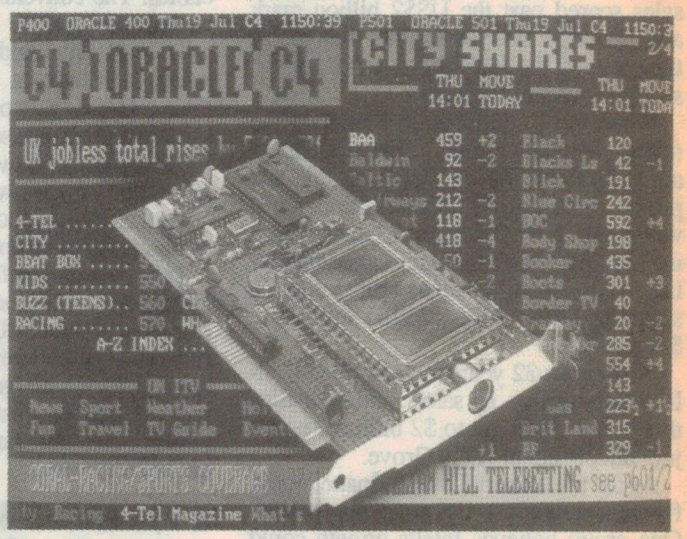
The Microtext Adaptor consists of a hardware and software pack which adds direct teletext reception and decoding facilities to a standard IBM-compatible PC.

The hardware side consists of a short 8-bit card which occupies a single slot, and combines a TV receiver front end with a full teletext decoder. Receiver tuning is fully software controlled, and the card mounting backplate carries only a standard PAL antenna connector.

As well as managing the receiver tuning (either auto scanning or manual) and providing channel memory facilities, the accompanying software provides a comprehensive range of teletext data manipulation facilities. Any desired teletext pages or data may be viewed on screen, printed out, saved on disk for later retrieval (in either ASCII text or graphics formats), or ported across to other software.

Currently this software runs under DOS, but a Windows version is in Beta test and will be available very shortly. The Windows version allows automatic searching of incoming teletext data for specified keywords — ideal for monitoring the news pages for items on specific topics, etc.

The Microtext Adaptor package is priced at only $515.00, making it very competitive with alternative approaches.



For further information circle 161 on the reader service card or contact Falvon Engineering, Lot Street, Gundaroo 2620; phone or fax (06) 236 8230.

READER INFO NO. 29

V32bis

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Low cost 486 colour notebook

Anabelle Bits is now offering its newest colour notebook computer, the Sunrace Hyperbook 3220S/33 priced at $4995. Featuring the new Cyrix 486S/33MHz processor, this machine also incorporates a new 'Dual Scan' LCD colour screen which delivers a performance close to that of conventional active matrix screens, but at a much lower price.

Manufactured by Sharp, the 9.5" VGA screen's circuitry makes two simultaneous sweeps from top to bottom and bottom to top, resulting in a display that has a much higher contrast and response time than a standard LCD, yet offers colour quality near to that of standard (and expensive) active matrix systems.

The Cyrix 486S/33 is a full 32-bit processor which offers power management facilities similar to Intel's SL range, clock doubling circuitry for 66MHz internal speeds, and adjustable clock rates so the processor can 'power down' to extend battery life.

Other innovative features of the Sunrace 3220S/33 are a built-in SCSI port for connection to a host of peripherals (CD-ROM etc), a 130MB *removable* hard disk, a second parallel port, a built-in trackball and numeric keypad, and the ability to run from standard C-type alkaline batteries.

For more information on the complete range of SunRace notebook computers circle 162 on the reader service card or contact Anabelle Bits, Unit 7, 5-15 Dunning Avenue, Rosebery, NSW 2018; phone (02) 313 6155 or fax (02) 313 6143.

VGA to video encoder

The TV Link by KDI Precision Products of Cincinatti Ohio is a 'Flicker Stable' external VGA to Video encoder. A full range of inputs and outputs allows you to adjust for flicker, image placement and overscan, to compensate for variations between video products. Full compatibility with USA's FCC standard RS-170A assures a clean signal for professional video production and broadcast.

The anti-alias filter helps to eliminate jitter even when using MS Windows — very useful when making software training and promotional tapes.

TV Link has RGB, S-VHS and composite video outputs, which means that the unit is suitable for professional video producers, as well as for businessmen using a TV set as a large screen monitor. It

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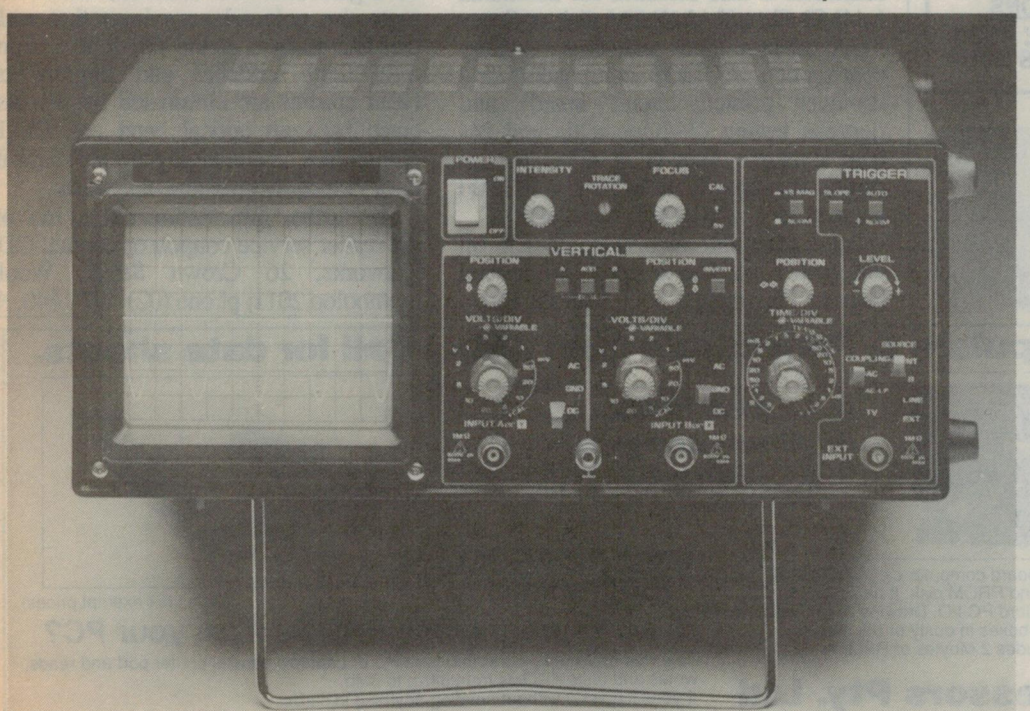
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READER INFO NO. 32

COMPUTER PRODUCTS

is fully compatible with analog video cards such as the New Media Graphics' Super Video Windows, Video Blaster, AVer 2000 and Media V, making it also suitable for recording interactive Multi-Media to video.

Presentations produced on AuthorWare, ICON Author and Tempra Media Author have the ability to play live video on the computer screen. The video usually comes off a laser disc player and is displayed on the VGA screen using one of the above cards. TV Link can record everything on the VGA monitor, including the live video, back to video tape. The price is $2250 including tax.

For further information circle 163 on the reader services coupon or contact Lako Vision Wholesale, 1/45 Wellington Street, Windsor 3181; phone (03) 525 2788.

Embedded 386 PC

With its small size (185 x 122mm) and complete features, Advantech's PCA-6134 is excellent for high performance embedded single-board-computer applications. In addition it its 386SX-33 CPU, socket for 387SX math coprocessor and HDD/FDD interfaces, the PCA-6134 offers special features for industrial/- embedded needs: RS-422/485 and RS-232 serial ports, bi-directional parallel port, onboard 1.44MB Flash/ROM disk emulator and a watchdog timer. A 64-pin piggyback bus connector is also included for additional 1.44MB Flash/RAM/ROM disk or Super VGA adaptor card. Industrial quality construction (CMOS components and six-layer printed circuit board) and rigorous testing (24-hour static and 24-hour dynamic burn-in at 60°C for all cards) resulting in a MTBF at 43,700 hours at 25°C and 21,000 hours at 60°C.

For further information circle 166 on the reader service coupon or contact Priority Electronics, 5/23 Melrose Stree, Sandringham 3191; phone (03) 521 0266, fax 521 0356.

CD-ROM recorder

The new Philips CDD 521 desk top optical disc recorder can write in every standardised CD format, including CD-ROM (XA), Photo CD, CD-I and CD-Audio, and is ideal for publishing large amounts of information in low quantity editions.

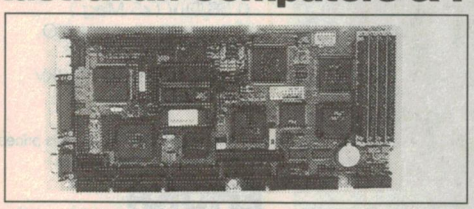
Typical applications in the professional field include low quantity corporate multi-media publishing, data storage and retrieval, database distribution, program verification and sampling before mass replication, and the production of master discs for CD authorising studios. Software distribution in CD format is extremely efficient in data-intensive environments such as CAD/CAM.

An important benefit offered by the CDD 521 is its ability to handle multi-volume recording, where data can be added to a partially recorded disc during up to 99 sessions. This is particularly important in applications such as database maintenance, archival or back-up storage and Photo CD, as — in the multi-volume recording mode — the contents of a disc may be read at any time, regardless of how many recording sessions have taken place.

The CDD 521, which has a storage capacity of 600MB offers very high data security. The CD discs are removable, and therefore can be secured within an organisation. In addition, there is a protective polycarbonate layer that seals the data surface of the CD-R disc from dust, light scratches and fingerprints. Head crashes are eliminated by the distance between optical head and CD-R disc surface, and there is powerful built-in error-detection/correction software.

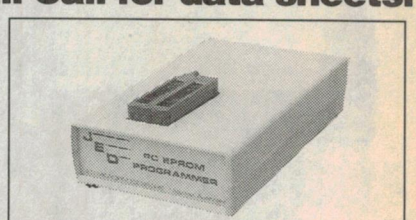
For further information circle 165 on the reader service coupon or contact CD-Networks, 26 Crown Street, Woolloomooloo 2011; phone (02) 357 1440. ❖

Australian Computers & Peripherals from JED... Call for data sheets.



The JED 386SX embeddable single board computer can run with IDE and floppy disks, or from on-board RAM and PROM disk. It has over 80 I/O lines for control tasks as well as standard PC I/O. Drawing only 4 watts, it runs off batteries and hides in sealed boxes in dusty or hot sites. It is priced at $999 (25 off) which includes 2 Mbytes of RAM.

$125 PROM Eraser,complete with timer



$300 PC PROM Programmer.

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Need to programme PROMs from your PC?

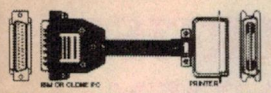
This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb.
It does it quickly without needing any plug in cards.

JED Microprocessors Pty. Ltd
Office 7, 5/7 Chandler Road, Boronia, Vic., 3155. Phone: (03) 762 3588 Fax: (03) 762 5499

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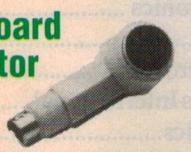
FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...

Printer Cables



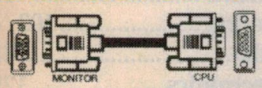
We offer three lengths for your convenience All DB25 to 36 pin Centronics with 18 pins wired. 2m **$7.95**, 5m **$12.95** and 10m **$25.95**

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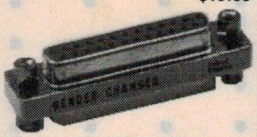
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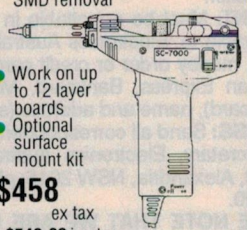


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The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron offering high quality soldering at lower tip temperatures. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.

Also available in ESD for antistatic environments. We stock a wide range of tips to suit. Ask for listing. **$183.95**

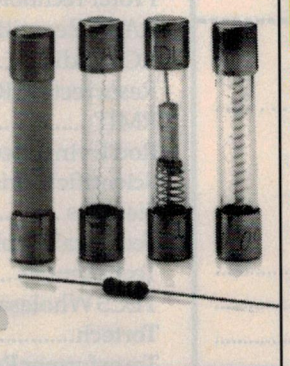
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HKO-483-T-0.8S	483 0.8mm Slim Tip	33.90
HKO-483-T-1.0	483 1.0mm Tip	33.90
HKO-483-T-1.0S	483 1.0mm Slim Tip	33.90
HKO-483-T-1.3	483 1.3mm Tip	33.90
HKO-483-T-1.3S	483 1.3mm Slim Tip	33.90
HKO-483-T-1.6	483 1.6mm Tip	33.90
HKO-483-CORE	483 Heater Core & Cover	57.85
HKO-483-PIN	483 Heater Core Pin	6.50
HKO-483-TOOL	483 Tip Removal Tool	15.60
HKO-483-FILT-SET	483 Filter Set & Pipe	11.60
HKO-483-DIAPHRAM	483 Diaphram Set	32.60
HKO-483-FILTERS	483 Filter Set 10 Piece	19.00
HKO-TIP-DS-0.8	Tip for 483/707/700	31.75
HKO-TIP-DS-1.0	Tip for 483/707/700	31.75
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HKO-800L-CORE	800L Heater Core	66.45
HKO-850-HEATER	850 Heater Element	58.10
HKO-850-HTR-PIPE	850 Heater Element Pipe	49.90
HKO-TIP-M-1.6D	1.6mm Dual Flat Tip	9.70
HKO-TIP-M-1.8H	1.8mm Offset Tip	16.40
HKO-TIP-M-1C	1.0mm Conical/Tip	9.70
HKO-TIP-M-1CF	1.0mm Conical Flat Tip	15.10
HKO-TIP-M-2.4D	2.4mm Dual Flat Tip	9.70
HKO-TIP-M-2C	2.0mm Conical Tip	9.70
HKO-TIP-M-2CF	2.0mm Conical/Flat Tip	15.10
HKO-TIP-M-3.2D	3.2mm Dual Flat Tip	9.70
HKO-TIP-M-3C	3.0mm Conical Tip	10.20
HKO-TIP-M-3CF	3.0mm Conical/Flat Tip	10.20
HKO-TIP-M-4C	4.0mm Conical Tip	10.65
HKO-TIP-M-4CF	4.0mm Conical/Flat Tip	10.20
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HKO-900M	Iron with 1.6mm Tip	59.55
HKO-900M-HEATER	Heater for 926	29.25
HKO-926-HOLDER	Complete 926 Iron Hldr	29.35
HKO-926-SPONGE	926 Tip Sponge	3.95
HKO-ANTI-SEIZE	Anti Seize Compound	3.80
HKO-GREASE	Silicone Grease	5.40

NOW STOCKING BUSSMANN FUSES

We are now stocking an extensive range of fuses and holders from Bussman. These include special replacement fuses such as the KTK series fast acting fuses for Fluke multimeters etc. We also stock the Microtron subminiature axial lead fuses and Pico ranges, IEC approved types etc.

The HKP Series Fuseholders take standard M205 fuses and have a vibration resistant bayonet cap. Introductory price **$2.95**





APPA

- ***Extra tough for industrial users***
- ***High energy fuse and PTC protection against overloading***
- ***O-ring sealed case, switch and jacks against dirt and moisture***
- ***Protective holster and tilt stand with lead storage***
- ***Test probes have finger shields and sleeved plugs***
- ***Thick walled ABS case and shock mounted LCD withstands 2m drop on to concrete floor***
- ***Unique rotary switch with berylium copper contacts and gold plated pcb***

Model 103 & 105

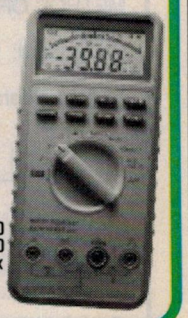
- 4000 count
- Digital update twice/second, analog 20 times/sec
- 8 Functions - Vdc, Vac, Adc, Aac, Ohms, Diode, Continuity, Frequency, Capacitance
- Data hold & Relative functions
- 0.5% dc accuracy

Ranges
Vdc 400mV- 1000V; Vac 4V- 750V
Aac/dc 4-400mA, 10A; Ohms 400Ω-40MΩ; Frequency 100Hz-1MHz
Capacitance 4nF-40μF

Model 103 **$298.80**
$249.00 ex tax

Model 105 has similar specs but with improved accuracy of 0.1% typ on Vdc and 0.5% at 50Hz

$358.80
$299.00
ex tax



8.30am to 5.00pm Mon to Fri. 8.00am to 12 noon Saturday.
Mail Orders add $5.00 min to cover postal charges.
Next day delivery in Sydney add $8.00.
All prices include Sales tax unless stated otherwise.
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Geoff Wood Electronics Pty Ltd and Semtech

(inc in N S W)

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N S W 2066 (Corner Beatrice Street)

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EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
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Dick Smith Electronics	ALL	•	•	•	•	•	•	•
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Geoff Wood Electronics	NSW	•	•	•	•	•	•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
Kalex	VIC			•				
Macservice	VIC						•	
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Rod Irving Electronics	VIC	•	•	•	•	•	•	•
Scientific Devices	VIC						•	
TECS	VIC	•	•	•	•	•	•	•
Wagner Electronics	NSW		•		•	•	•	

KEY TO CODING:
A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).
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Photostat Copies:.....
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No.of issues required:.....$7.50=.....
No.of copies required:.....$5.00=.....
No.of copies required:...$15.00=.....

Total Payment Enclosed $ =========

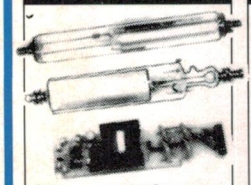
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12V OPERATED LASER TRIO



One used 3mW Siemens tube, one used laboratory quality 2mW tube, one universal 12V laser inverter kit, for a total of:

$99

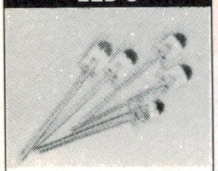
FANS



Brand new German made PAPST brand 115V-12W fans with metal blades. Overall dimensions 80 X 80 X 38mm. Use two in series to run off mains?

LIMITED STOCKS **$14**

HIGH INTENSITY LED's



Narrow angle 5mm red LED's in a clear housing. Have a luminous power output of 550-1000mCD @ 20mA: That's about 1000 times brighter than normal red LED's.

SPECIAL UNBELIEVABLE INTRODUCTORY PRICE:

50c ea. or **10 for $4,** or **100 for $30.**

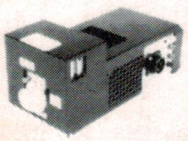
LIGHT MOTION DETECTOR



Small PCB assembly based on a ULN2232 IC. This device has a built in light detector, filters, timer, narrow angle lens, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness with IR LED. Full information provided. The IC only is worth $16! Our price for the assembly is:

$6 ea. or **5 for $25**

ARGON HEADS

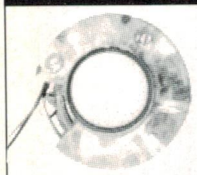


These low voltage air cooled Argon Ion Laser Heads are priced according to their hours of operation. They produce a bright BLUE BEAM (488nM) and a power output in the 10-100mW range: Depends on the tube current.

The head includes power metre circuitry, and starting circuitry. We provide a simple circuit for the supply and can provide some of the major components for this supply. Limited supplies at a fraction of their real cost:

$450-800

IMAGE INTENSIFIER TUBE AND NIGHT VIEWER KIT



These 18mm image intensifier tubes are similar to ones used in night vision equipment during the Gulf War. They are ex-military and may have some minor blemishes on the viewing screen. With suitable low light lenses they will produce good vision in as little as starlight illumination. The tubes require a 3V battery to make them operational.

$490 for the tube only



The viewer illustrated was made using some low cost plastic tubing and matching fittings, a low light camera lens, and an eyepiece. We can supply a custom machined kit of parts (Mostly aluminium) for our latest casing: This kit includes everything except the front lens and the battery. The eyepiece is included.

$98 for the case kit without the front lens

The lens we used is a 50mm "C" mount f1.4 video lens, for a 1" format (Cosmicar type: B5014A) and we will supply details of a supplier of this lens: Approx. $130.

PROFESSIONAL MICROPHONE CABLE

High quality twin core flexible shielded microphone cable. Heavy duty construction, red in colour, overall diameter is 6mm, has a tightly woven shield and two 24 strand centre conductors (Red and black). Uses lots of copper: The resistance of one of the centre wires is 2.4ohms per 100 metres, which is lower than the resistance of one of the conductors in a typical 10A mains extension lead! The resistance of the shield is 1.4ohms per 100 metres. Excellent for professional use in rugged environments and stage use. Also suitable for low voltage shielded power cables. Priced at a small fraction of its real value:

$1.50 per metre. Bulk discounts apply: "ring".

SOLAR CHARGER

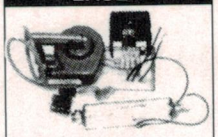


Use it to charge and or maintain batteries on boats, for lighting, solar powered electric fences, etc. Make your own 12V-4W solar panel. We provide four 6V-1W solar panels with terminating clips, and a PCB and components kit for a 12V battery charging regulator and a three LED charging indicator. See March 93 S.C. Incredible value!

$42

6.5Ahr. Panasonic gel battery $35. Electric fence PCB and all onboard components kit $40: See S.C. April 93. **The panels can be purchased seperately at $9Ea. or 4 for $32, or 10 for $70.**

EL-CHEAPO LASER



Probably the cheapest visible red helium neon laser and power supply ever offered, ANYWHERE! The kit includes a PCB, transformer, and all the components needed to make a 12V operated laser power supply, and a used laser tube with a power rating in the 0.5-2mW range. The PCB and all the onboard assembly is the same as the one used in our EHT Generator (it also now comes with a PCB), but a few extra necessary components and corresponding instructions are provided with the kit. Incredible value at:

$50

For the 12V inverter kit and a visible red laser tube. The EHT generator kit is available separately for $23.

ARGON OPTIC SETS

If you intend to make an Argon laser tube, the most expensive parts you will need are the two mirrors contained in this ARGON LASER OPTIC SET. Includes one high reflector and one output coupler at a fraction of their real value. LIMITED SUPPLY.

$200 for the two Argon LASER mirrors.

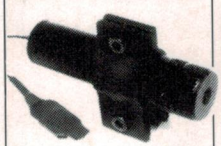
JOYSTICK CONTROLS



Brand new good quality Japanese made joystick controls with four 100K pots attached. Great for computers, audio amplifiers, laser pattern generators etc.

$3 ea. or **4 for $10**

LASER GUN SIGHT



A 5mW gunsight at a super reduced price.

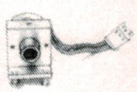
$229

Includes one "Free" rifle or pistol mount.

IR LASERS

REDUCED PRICES! This precision collimator assembly is supplied with a brand new laser diode to suit. Produces a well collimated laser beam at 780nM/5mW. Barely visible. We also supply a PCB and components kit plus instructions, for a suitable digital driver circuit that can be used to complete the laser transmitter. Suitable for communications, data links, perimeter protection, barcode reading, medical use, etc.

$69



We can also supply a similar kit which includes a laser diode, unmounted lens, and a driver kit **$39**

LARGE NIGHT VIEWER

One of a kind! A very large complete viewer based on a three stage fibre optically coupled 40mm first generation image intesifier, with a low light 200mm objective mirror lens. This viewer would normally be tripod mounted. Probably the highest gain — resolution night viewer ever made. ONE ONLY at an incredible price of:

$3990

LARGE LENSES



Two pairs of these new precision ground AR coated lenses were orginally used to make up one large symetrical lens, for use in IBM equipment. Made in Japan by TOMINON. The larger lens has a diameter of 80mm and weighs 0.5kg. Experimenters delight at only:

$15 for the pair.

SPEAKER GIVEAWAY



One 3" tweeter, one 4" woofer, a non polarized crossover capacitor, plus a diagram:

$10 for the set or 2 sets (STEREO) for $18!!

We don't have much more information on these new components that appear of high quality. The tweeter alone is worth over $12.

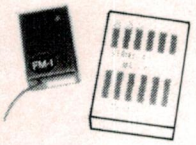
8MM VIDEO CASSETTES



These 120 minute 8mm metal oxide video cassettes were recorded once for a commercial application, and then bulk erased. They are in new condition but don't have the record protect tabs fitted: The hole in the upper right corner will have to be taped over.

$9 ea. or **5 for $38.**

MINIATURE FM TRANSMITTER



Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. SPECIFICATIONS: Tuning range: 88-108MHz, Antenna: Wire antenna — attached, Microphone: Electret condenser, Battery: One 1.5V silver oxide LR44/G13, Battery life: 60 hours, Weight: 15g, Dimensions: 30 X 20 X 10mm.

ONLY **$32**

BC548 TRANSISTORS

Brand new Philips brand BC548 transistors with in line leads and taped to a cardboard strip. Designed for automatic insertion machines. Leads are spaced by 2.5mm and 13mm long. A BARGAIN:

100 for $6

12V OPERATED LASERS WITH KIT SUPPLY

Save by making your own laser inverter kit. This combination includes a new He-Ne visible red laser tube, and one of our 12V Universal Laser Power Supply MKIII kits. This inverter is easy to construct as the transformer is assembled. The supply powers He-Ne tubes with powers of 0.2-15mW.

$130 with 1mW Tube

$180 with 5mW Tube

$280 with 10mW Tube

PHOTOINTERRUPTER

An IR LED and an phototransistor in a slotted PCB mounting assembly. The phototransistor responds to visible and IR light. The discret components are easy to seperate as the assembly clips together. Great for IR experiments

$2 ea. or **10 for $15**

OATLEY ELECTRONICS

PO Box 89, Oatley, NSW 2223

Telephone: (02) 579 4985 Fax: (02) 570 7910

MAJOR CARDS ACCEPTED WITH PHONE AND FAX ORDERS

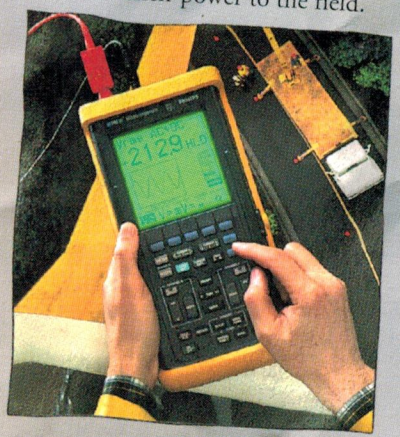
P & P ANYWHERE IN AUSTRALIA FOR MOST MIXED ORDERS: $2.50-$10

READER INFO NO. 36

On-the-Go

THE PORTABLE WORKSHOP

Unique combination tools take bench-power to the field.



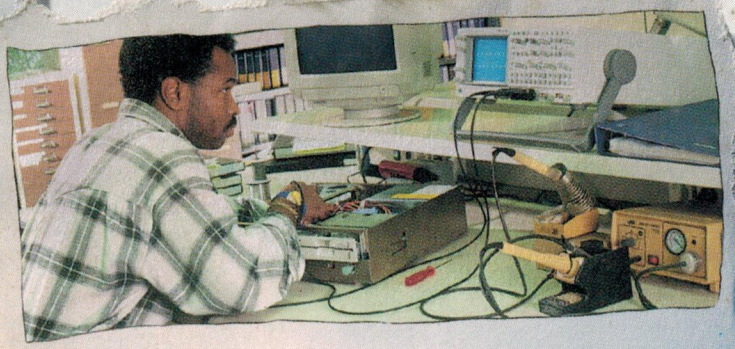
The T&M world demands a lot from its field engineers. But whether you're up a ladder or down on the field, when the going gets tough and you need more tools than you can carry, Fluke and Philips bring to hand a tough and innovative range of field tool solutions.

Freeing the power of the bench to the field, these tools range from basic DMMs through the general purpose CombiScope™ to the highly innovative ScopeMeter™.

ScopeMeter™ is the first truly integrated scope and meter in one instrument. Attractively priced, and weighing just 1.8 kg, think of it as a handheld oscilloscope built for the great outdoors with the attraction of a built-in meter.

Tough. Portable. Flexible. Fluke and Philips have a unique combination of tools for today's tough field work.

On-the-Bench



The best of both worlds with two scopes in one

The power of digital and the familiarity of analog in one scope

Two heads are better than one.

Fluke and Philips have put their analog and digital minds together and created the CombiScope™.

Two instruments in one, CombiScope™ combines analog resolution and familiarity with digital performance.

The ease of switching between the two modes makes it ideal for manufacturing, servicing and testing.

There are many CombiScope™ models to choose from. From low cost 2 channel CombiScopes to high performance CombiScopes with 200 MHz bandwidth, 200 MS/s, four channels and advanced mathematical functions like FFT.

The Fluke and Philips CombiScope™. Twice the scope. Twice the performance.

BENCH BULLETIN NEW

Four more new products just announced by Fluke and Philips

- **PM 3331 Low cost CombiScope™**
  Low budget CombiScope™ with 40 MHz bandwidth, 20 MS/s sample rate, 8K acquisition memory and standard RS-232 interface.
- **PM 5330 ARI/RDS Radio Test Generator**
  The wide ranging frequency, output levels and modulation facilities make the advanced PM 5330 ideal for testing, alignment and troubleshooting of (car) radios.
- **PM 5150 Arbitrary waveform generator**
  The PM 5150 offers unlimited waveform generation and waveform creation.
- **Hydra Data Bucket**
  Data acquisition unit with removable RAM memory card for flexible and powerful PC-based data acquisition.

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You'll measure better performance

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